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EPA Superfund
Record of Decision:

SAND CREEK INDUSTRIAL
EPA ID: COD980717953
OU 04
COMMERCE CITY, CO
04/07/1994

Text:

RECORD OF DECISION
DECLARATION STATEMENT

SITE NAME AND LOCATION

Site-wide groundwater, Operable Unit 4 (OU4), Sand Creek Industrial Superfund Site, Commerce City, Colorado.

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedy for Operable Unit 4 (OU4), Site-wide groundwater at the Sand Creek Industrial Superfund Site in Commerce City, Colorado. This remedy has been developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), applicable state laws, and the National Oil and Hazardous Substances Pollution Contingency Plan (the National Contingency Plan (NCP), Title 40 Code of Federal Regulations Part 300). This decision is based on the administrative record for OU4.

The State of Colorado is expected to concur with the selected remedy.

ASSESSMENT OF THE SITE

The Sand Creek Industrial Superfund Site has an extensive history of industrial use, including pesticide manufacturing, petroleum refining, acidic waste disposal, municipal landfilling, and chemical storage and distribution. OU4 addresses groundwater underlying the Site and is contaminated with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and metals. OU4 also includes a plume of light non-aqueous phase liquid (LNAPL) floating on the water table beneath the northwest portion of the Site. The migration of groundwater contaminants tends to be impeded by the presence of impermeable clayey materials.

Although groundwater in the area is classified as a potential drinking-water supply by the State of Colorado, there is no unacceptable current health-risk due to ingestion, inhalation, or skin contact with contaminated groundwater since water for residential use is provided through treated water from either the Denver Water Department or the South Adams County Water and Sanitation District. However, risks associated with potential future use of groundwater for domestic purposes are unacceptable. Actual or threatened releases of hazardous substances from OU4, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

The remedy selected for OU4 will minimize direct contact with and ingestion of groundwater underlying the Site and prevents further offsite migration of contaminants in excess of federal and state groundwater standards. The major components of the selected remedy include:

- Implementation of institutional controls that will minimize exposure to contaminated groundwater at OU4 by limiting groundwater usage to non-domestic purposes and preventing any usage of highly contaminated groundwater.

- Quarterly groundwater and surface water monitoring to evaluate contaminant migration and changes in site conditions.

- Removal of the recoverable portion of the LNAPL plume located in the northwest portion of the Site with a dual vapor extraction (DVE) system. Recovered LNAPL will be transported off site to a recycling facility.

- Onsite infiltration of treated groundwater removed incidentally by operation of the DVE system.

- Five-year site reviews will be conducted at OU4 and additional remedial action will be taken if warranted by a change in site conditions.

STATUTORY DETERMINATIONS

The selected remedy provides protection to human health by limiting exposure to and preventing ingestion of contaminated groundwater through institutional controls. This alternative protects the environment by requiring groundwater and surface water monitoring to ensure that OU4 contamination does not impact Sand Creek or downgradient aquifers at some future date. Removal of the recoverable portion of the LNAPL plume will effectively eliminate a source of groundwater contamination at OU4.

The selected remedy is protective of human health and the enviromnent, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this site, but because treatment of the principal threats of OU4 was not found to be feasible, this remedy does not satisfy the statutory preference for treatment as a principal element. However, many of the principal threats at the Site are being addressed under other operable units. Because this remedy will result in hazardous substances remaining on site, a review will be conducted every five years to ensure that the remedy continues to provide adequate protection of human health and the environment.

William P. Yellowtail — Date
Regional Administrator
U.S. Environmental Protection Agency, Region VIII

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Operable Unit 4
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I. SITE NAME, LOCATION, AND DESCRIPTION

The Sand Creek Industrial Superfund Site (Site) occupies about 300 acres within portions of both Commerce City in Adams County, Colorado and the City and County of Denver. The Site is bounded on the north by Interstate 270, on the south by East 48th Avenue, and on the east by Ivy Street and the eastern extent of the 48th and Holly Landfill. The western boundary is approximated by Colorado Boulevard, Vasquez Boulevard, and Dahlia Street (Figure 1). Four known sources of contamination are present at the Site and all are currently inactive: the Colorado Organic Chemical Company (COCC) property, the 48th and Holly Landfill, the L.C. Corporation (LCC) property, and the Oriental Refinery property. Operable Unit 4 (OU4) of the Sand Creek Industrial Superfund Site addresses groundwater affected by these four sources and is the focus of this Record of Decision (ROD).

Land use near the Site is primarily industrial and includes trucking firms, petroleum refining operations, chemical production and supply companies, warehouses, and small businesses. Several other Superfund sites are also located in the area, including the Rocky Mountain Arsenal, Chemical Sales Company, and Woodbury Chemical sites. Properties adjacent to the Site are zoned for light and heavy industrial uses, industrial park, industrial park storage, and agricultural uses. Fifteen residences housing approximately 25 people are located within a one-mile radius of the Site. The daytime population reaches several hundred due to local businesses and the industrial nature of the area.

The Denver portion of the Site is located south of East 52nd Avenue west of Forest Street and south of East 48th Avenue to the east of Forest Street. This area is zoned for heavy industrial use. No changes in zoning are anticipated by the City and County of Denver Planning Administration (CCDPA) in the near future. CCDPA indicates that long-range land-use plans will depend on the fate of Stapleton International Airport following completion of the new Denver International Airport. The Commerce City portion of the Site is zoned for agricultural and heavy industrial use. Commerce City's Comprehensive Plan for 1985 to 2010 indicates that future land use of this area will be primarily industrial with a recreation/open space designation for the Sand Creek floodplain.

Municipal water for the area surrounding OU4 is supplied by the South Adams County Water and Sanitation District (SACWSD) and the Denver Water Department (DWD). Groundwater produced from alluvial and bedrock wells located north of I-270 is a major source of water supplied by SACWSD. Water supplied by the DWD is obtained primarily from surface-water sources located outside of the Site area. Residents near the OU4 area are not currently using contaminated groundwater for domestic purposes.

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II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

During the 1970s and early 1980s a variety of environmental contamination was discovered and identified at the Site by EPA's Field Investigation Team (FIT). This contamination has resulted from at least four sources: The COCC facility; the LCC property; the Oriental Refinery site; and the 48th and Holly Landfill. Although the ownership and the operations on these properties were distinct, they were included together as the Sand Creek Industrial Superfund Site and placed on the National Priorities List (NPL) in 1982 for cleanup under the Comprehensive Environtnental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). Under the Superfund law, the Environmental Protection Agency (EPA) is charged with the responsibility of developing and implementing cleanup remedies that protect human health and the environment.

Oriental Refinery Property. The Oriental Refinery was located on the northwest corner of 52nd and Dahlia and was gutted by a fire in 1955. As a result of the fire, approximately 48,000 gallons of refined petroleum products may have been released from storage tanks. Plant operations and the fire have resulted in groundwater contamination. The Tri-County Health

Department (TCHD) sampled the soils at the old refinery site and found hydrocarbon contaminated soils to a depth of 28 feet. The FPA Field Investigation Team (FIT) investigated the Site in 1980 and found diesel fuel contamination in several groundwater monitoring wells.

Colorado Organic Chemical Company Property. The COCC plant originally manufactured pesticides in the 1960s under the name of Times Chemical. The COCC site has been the scene of two fires, both of which occurred when the facility was operated by Colorado International Corporation (CIC). In 1968 a fire destroyed three buildings. In December 1977 a fire destroyed the manufacturing equipment within the facility. Eight hundred people were evacuated and at least 26 people were treated for the inhalation of toxic parathion fumes. Firefighters sprayed more than 350,000 gallons of water on the blaze and subsequently washed the pesticite-contaminated water downhill toward Dahlia Street. After these fires several health agencies found unacceptable conditions at the plant, including: unsatisfactory waste management practices; unsatisfactory worker safety conditions; violations in storage and handling of flammable liquids; and soil containing high levels of thermally altered pesticides and other chemicals.

Immediately after the December 1977 fire, the Colorado Department of Health (CDH) issued an Emergency Cease and Desist Order to CIC, Western United Resources, Globe Chemical, Chicago, Rock Island and Pacific Railroad, and Mr. Phillip Mozer. This order stated that the operations on the Site must be halted, the area contaminated by the fire must be isolated, and among other tasks, the fire-damaged material must be left intact. Although Western United Resources was named in the Order, documentation has not been found to indicate that they participated in any operations relevant to the Site.

A March 1984 report described the COCC facility as an unfenced site consisting of six structures, ten large above-ground tanks (ranging in size from 2000 to 20,000 gallons), and an uncovered drum storage area. The six structures contained, among other items, approximately 50 drums and an uncertain quantity of pesticide bags. Of the approximately 100-125 total drums observed both in the open storage area and in the buildings on site, most were unlabeled and many were rusted, corroded, bulging, stressed, and leaking. Later in 1984, COCC removed waste drums and contaminated soil, and constructed a fence around the area in response to an order from EPA.

Between 1985 and 1990, Remedial Investigation/Feasibility Study (RI/FS) activities occurred at the COCC property as part of the Sand Creek Superfund Site studies. Treatability studies were also performed to evaluate the effectiveness of soil washing and bioremediation technologies in cleaning up soil contamination attributable to the COCC facility. During 1991 and 1992, approximately 2,000 cubic yards of debris, induding four buildings, four rail cars, two concrete tanks, and 13 steel tanks were removed by a licensed hauler and disposed of in permitted landfills. Soil vapor extraction (SVE) operations, designed to remove volatile organic compounds from subsurface soil, began at the COCC property during the summer of 1993. This remedial action is documented in the Explanation of Significant Differences (ESD, 1992) to the Operable Unit 1 (OU1) ROD (1989). Low Temperature Thermal Treatment (LTTT) was selected as the method for cleaning up soils contaminated with pesticides and metals at COCC in the Operable Unit 5 (OU5) ROD Amendment (1993). Remediation of OU1 and OU5 is expected to be completed in 1994.

L.C. Corporation Property. The LCC property has been a part of Commerce City industry since 1948. Between 1948 and 1958, part of the property was used as a gravel quarry. In 1968, Shell Chemical Company contracted with LCC for the disposal of spent acidic wastes from Shell's chemical plant at the Rocky Mountain Arsenal. LCC was to line its disposal impoundments with an ethylene propylene copolymer film before disposing of any acidic wastes. A liner was installed, however, it was breached after acidic wastes were deposited in the pits. Approximately 7,810 tons of sulfuric acid were disposed of in the LCC pits.

In November 1974, TCHD investigated a complaint involving severe chemical burns to livestock that had strayed onto the LCC property. TCHD found pools of liquids in lined pits on the property. LCC agreed to clean up the liquid after analysis showed that it was a 30% sulfuric acid solution with a highly acidic pH of 0.75.

In July 1975, TCHD employees discovered a seep discharging acidic liquid into Sand Creek. Analyses of the seep liquid and water from Sand Creek in 1976 indicated that both contained a sulfone believed to be an intermediate by-product from Shell's manufacture of the herbicide

Planavin.

In 1980, at the request of CDH, LCC used lime to neutralize the pits and filled them with clean backfill. Sampling indicates that the lime was effective in neutralizing the acid pits, and that the pits do not pose an unacceptable risk to public health, as documented in the Operable Unit 2 (OU2) ROD (1993).

48th and Holly Landfill. Waste disposal operations were conducted from 1968 to 1975 at the 48th and Holly Landfill (Landfill). The Landfill accepted both demolition and domestic refuse, and although known hazardous and pathological wastes were reported to be excluded from disposal, the method of exclusion and the consistency of its application are unknown.

In 1977, two explosions of combustible gas were traced to the migration of methane gas from the Landfill. Two passive methane gas venting systems, which proved to be ineffective, were installed at the Landfill in 1978 and 1980. In 1991, the passive systems were replaced with an active landfill gas extraction system (LFGES) as part of the Sand Creek Superfund Site activities at Operable Units 3 and 6 (OU3/OU6). The landfill-gas collected by the LFGES is burned using an enclosed flare to destroy contaminants and eliminate odors. Condensate produced within the system is collected, treated, and discharged to a sanitary sewer.

After the Landfill ceased operation in 1975, the site was covered with between 1 to 10 feet of sandy soil, and re-vegetated. In response to erosion, ponding due to differential compaction within the refuse, and areas lacking well established vegetative cover, several site improvement activities were undertaken in 1992. These site improvements included fill placement, erosion control, and reclamation.

Site-Wide Groundwater. The groundwater underlying the Sand Creek Industrial Superfund Site has been contaminated from the four onsite sources (the COCC facility; the LCC property; the Oriental Refinery site; and the 48th and Holly Landfill). In addition, some contaminated groundwater is moving on site from the Chemical Sales Company Superfund site and unidentified upgradient source(s). The site-wide groundwater is addressed under this OU4 ROD.

Residuals and breakdown products of chemicals contaminating the soils at the COCC facility have been found in the groundwater. The soils at the Oriental Refinery have been contaminated with hydrocarbons and petroleum contamination has been found in monitoring wells. The acid wastes disposed of in pits on the LCC property impacted both groundwater and surface water in Sand Creek. Contamination from the Landfill has impacted the groundwater at the Site. At the present time no known contamination is entering the surface water of Sand Creek from the Site.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Community interest in OU4, specifically, and the Sand Creek Industrial Superfund Site, in general, has been limited. EPA has undertaken several community relations activities as part of the recent site history.

Community involvement activities for the Site began in April 1985. EPA distributed an introductory fact sheet to area residents, businesses, and agencies. The fact sheet provided background information about the Site and an explanation of the Superfund process. EPA also attended a public meeting organized by the Citizens Against Contamination, a local group from the area, and compiled a list of property owners for the entire site.

EPA mailed a second fact sheet for the Site in November 1985. This fact sheet provided additional information on investigation and clean-up activities associated with the Site. During the same month, EPA provided a groundwater contamination briefing at a second public meeting held by the Citizens Against Contamination.

In January 1986, EPA contacted property owners and Commerce City officials to inform them of activities at the Site. In April 1987, EPA surveyed area residents about their water use habits to determine future outreach efforts.

An RI report describing the nature and extent of contamination at the Sand Creek Industrial Superfund Site was released for public review in March 1988. In May 1988, EPA contacted owners for permission to sample soils on their property. In October 1988, EPA met with Commerce City

officials to brief them and solicit their reaction to cleanup plans for the site.

On three occasions in 1990, EPA held public meetings addressing all of the Superfund sites in South Adams County, excluding the Rocky Mountain Arsenal. In the fall of 1991, community interviews were conducted to update the site Community Relations Plan (CRP) originally issued in December 1984. The CRP outlines community concerns, EPA's strategy for implementing the plan, and establishes information repositories. A list of contacts and interested parties throughout government and the local community are also provided. The revised CRP was released in December of 1991. In addition to meeting directly with the public, EPA and the CDH have met with the TCHD, SACWSD, Rocky Mountain Arsenal personnel, Commerce City/Adams County officials, Metro Waste Water officials, and Representative Patricia Schroeder's staff to update them on activities.

EPA issued the Proposed Plan for OU4 on February 14, 1994. The Proposed Plan and RI reports were made available to the public through the Administrative Record maintained at the EPA Region VIII Superfund Records Center in Denver and at the information repository at the Adams County Library. A notice of availability of these documents and notification of the public meeting were published in The Rocky Mountain News on February 14, 1994 and in The Commerce City Express on February 15, 1994.

The public comment period was open from February 14 to March 16, 1994. The public meeting was held on March 1, 1994 at the Commerce City Recreation Center. EPA explained the alternatives and responded to questions. A transcript of the public meeting has been entered into the Administrative Record. A Responsiveness Summary, prepared by EPA to address public comments, is included as Appendix A of this ROD.

IV. SCOPE AND ROLE OF RESPONSE ACTION

Due to the complex nature of the Sand Creek Industrial Superfund Site, EPA has divided it into six operable units (OUs), or study areas, in order to more effectively address specific contamination problems. The OUs were established based on the types of contaminants present, the type of media affected, and physical characteristics. As discussed above, this ROD for OU4 addresses the principal potential threats to humans and the environment resulting from exposure to contaminated groundwater throughout the Site. The six operable units at the Site are defined as follows:

- Operable Unit 1: OU1 addresses contaminated buildings, soil contamination greater than 1000 parts per million (ppm), and volatile organic compounds (VOCs) in the subsurface soils. The OU1 area indudes approximately 15 acres of the site, including the COCC plant property, the land between COCC and LCC, and the northern portion of the Oriental Refinery site. The Explanation of Significant Differences (ESD; 1992) to the OU1 ROD (1989) selected SVE as the method for removing VOCs from soils ranging in depth from 8 to 20 feet at OU1. The purpose of the OU1 ROD and ESD was to address the principal threat of contact with contaminated soils by the public and Site workers, and to protect surface water and groundwater resources. The OU1 ROD and ESD called for a cleanup of chloroform, methylene chloride, tetrachloroethene, and trichloroethene in the subsurface soils. In addition, demolition and removal of contaminated tanks and buildings located in the area was included in the selected remedy.

- Operable Unit 2: This OU addresses the acid waste disposal pits on the LCC property, just north of the COCC facility. The pits located there were used for disposal of acid waste from various chemical manufacturing activities occurring both off and on site. The OU2 ROD (1993) selected a No Further Action alternative for the acid pits.

- Operable Unit 3: This OU comprises the 48th and Holly Landfill and specifically includes contaminated surface water, groundwater, sediment, soil, and air in its vicinity. The OU3/OU6 ROD (1993) selected a remedial alternative for the Landfill. The ROD called for both engineering and institutional controls. Engineering controls included the continued operation and maintenance of the landfill gas extraction system (LFGES). The ROD also dictated that the landfill

cover system be maintained, and groundwater in the vicinity of the Landfill be monitored for potential releases of contaminants from the Landfill. In addition, the OU3/OU6 ROD provides that if it is determined by EPA, in consultation with CDH, that the Landfill is responsible for a contaminant release to groundwater outside the boundary of OU3, such release(s) will be addressed under OU3.

- Operable Unit 4: This study area is the focus of this ROD and consists of contaminated groundwater underlying the Sand Creek Industrial Superfund Site. However, groundwater beneath the 48th and Holly Landfill and groundwater directly related to the Landfill is being addressed under the OU3/OU6 ROD. OU4 also includes the light non-aqueous phase liquid (LNAPL) plume floating on the water table beneath a portion of the Site. Petroleum contamination is generally excluded from CERCLA investigations due to the Petroleum Exclusion. However, EPA included LNAPL in OU4 because the product is mixed with hazardous substances, the presence of hydrocarbons in the subsurface adversely affects SVE remediation at OU1, and the LNAPL provides a continuous source of dissolved-phase contaminants to groundwater. Contaminants detected in the groundwater include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, metals, and sulfones.

- Operable Unit 5: OU5 includes the same area as OU1 but addresses pesticides and heavy metals in shallow soils to a depth of 5 feet. These soils have contaminant concentrations greater than action levels and less than or equal to 1,000 ppm of halogenated organic compounds (HOCs). The remedy selected in the OU5 ROD (199O) called for soils at the COCC property with concentrations above action levels to be excavated and treated on site using a soil washing process. Subsequent to the OU5 ROD, EPA analyzed additional samples of the contaminated soils, performed soil washing treatability studies, and investigated other cleanup technologies. As a result of this additional work, EPA selected the use of Low Temperature Thermal Treatment (LTTT) in the OU5 ROD Amendment (1993) as the method for cleaning up contaminated soils. It is estimated that approximately 8,000 cubic yards of contaminated soil will require treatment at OU5.

- Operable Unit 6: This OU addresses the gaseous emissions at the 48th and Holly Landfill. The remedy for OU6 was selected in the OU3/OU6 ROD (see OU3 above) and called for continued operation of the LFGES installed as part of a removal action in 1991.

V. SUMMARY OF SITE CHARACTERISTICS

The Sand Creek Industrial Superfund Site is located in an urban environment that has been extensively modified by industrial development over the past 50 years. The Site lies in an area of low relief within the Sand Creek floodplain, which is part of the South Platte River system. The on-site drainage represents less than one-half of one percent of the total drainage to Sand Creek. The only surface-water feature within the Site is a 1-acre wetland that is fed by a subsurface drain system and is located immediately north of the Landfill.

This Site is in an area classified as mid-latitude semiarid, indicating an area of high summer temperatures, cold winters, and sparse rainfall. The average annual precipitation is approximately 15 inches.

A. Topography

Topography in the area rises gently to the south, with elevations ranging fmm approximately 5,180 feet above mean sea level (MSL) in the northwestern corner of the Site to approximately 5,250 feet MSL in the southeastern corner. Interpretation of natural features is complicated by the extensive amount of fill that has been brought into the area. Between 2 and 10 feet of soil capping material currently covers the refuse at the Landfill and similar thicknesses of fill materials occur locally in other parts of the Site. Natural drainage paths have also been altered by development in much of the area.

B. Geology

The subsurface geology in the vicinity of the Site consists of Quaternary alluvial deposits and Tertiary bedrock. Alluvial deposits range in thickness from less than 20 feet to more than 100 feet and consist of sand, silt, and clay of the Piney Creek Alluvium, eolian deposits of silt and clay, and sand and gravel of the Broadway Alluvium. Clay and gravel sediments of the Slocum Alluvium are also locally present. Bedrock in the area is made up of claystone, shale, siltstone, and sandstone of the Denver Formation. In the central portion of the Site, a paleochannel is eroded in the bedrock surface and may influence the occurrence and movement of groundwater in the area. The Denver Formation is underlain by the Arapahoe Formation, Laramie Formation, and Fox Hills Sandstone. Outcrops of bedrock are not visible at the Site.

C. Hydrogeology

Three discrete alluvial aquifers (Aquifers 0, 1, and 2) have been identified within the unconsolidated sediment overlying bedrock in the area. Borehole logs taken from investigations in the vicinity of the Site show that alluvial deposits are composed of relatively high permeability sands and gravels interbedded with low permeability clayey and silty material. The extensive amount of clay material present in the subsurface at the Site tends inhibit groundwater flow and contaminant migration. A generalized cross-section of the aquifer system at the Site is provided in Figure 2.

In the southeastern portion of the Site, Aquifer 0 is the only alluvial aquifer present (Figure 3), and it directly overlies bedrock or fine-grained alluvial sediments overlying bedrock. In the central part of the Site, Aquifer 0 exists under perched conditions above Aquifer 2. The lateral extent of Aquifer 0 is limited to the northwest. Aquifer 0 is unconfined throughout its extent and is underlain by a low permeability clayey layer (Aquitard A), which inhibits downward movement of groundwater. Within Aquifer 0, groundwater flow is generally toward the north to northwest. Slug test data from Aquifer 0 wells indicate that the horizontal hydraulic conductivity typically ranges from 0.6 to 1.0 foot per day (ft/d), but was measured to be as high as 354 ft/d at one well. The hydraulic gradient of Aquifer 0 ranges from 0.004 to 0.06 foot per foot (ft/ft). Using an estimated effective porosity of 20%, average flow velocities calculated by Darcy's Law range from 0.03 to 17.7 ft/d for Aquifer 0.

Aquifer 0 receives recharge from upgradient of the Site and discharges to Aquifer 2 where the confining unit (Aquitard A) separating these aquifers pinches out in the northwest portion of the 48th and Holly Landfill. It is believed that Aquifer 0 also discharges to the spring located north of the Landfill via a finger drain system. The direction of groundwater flow in Aquifers 0 and 2 is generally consistent with the regional flow direction of the alluvial system (i.e., northerly toward Sand Creek).

Aquifer 1 is present in the northwestern portion of the Site and northwest of the Site (Figure 3). Aquifer 1 exists under unconfined conditions and is separated from Aquifer 2 by a clayey impermeable unit (Aquitard B). Groundwater flow within Aquifer 1 is generally toward the east/northeast. Groundwater may discharge from Aquifer 1 to Aquifer 2 in the area where the confining unit separating these aquifers pinches out, in the vicinity of the northern boundary of the Landfill. Data from slug tests performed on Aquifer 1 wells indicate the horizontal hydraulic conductivity ranges from 0.7 to 273 ft/d. The average hydraulic gradient of Aquifer 1 is 0.006 ft/ft. Using an estimated effective porosity of 2O%, average flow velocities calculated by Darcy's Law range from 0.02 to 8.2 ft/d for Aquifer 1.

Aquifer 2 is present over the western portion of the Site (Figure 3). Aquifer 2 underlies Aquifer 0 and Aquifer 1 in areas where present and also overlies fine-grained alluvial sediments overlying bedrock. The extent of hydraulic communication between Aquifer 2 and Aquifers 0 and 1 is not known, but it is believed that some leakage occurs across the aquitards (A and B) that separate these aquifers. In addition, the limited extent of the aquitards allows groundwater from Aquifers 0 and 1 to discharge to Aquifer 2 where the aquitards pinch out. Downward vertical flow velocities from Aquifer 1 to Aquifer 2 are calculated to range from 0.0009 to 20 ft/d. Aquifer 2 exists under confined conditions to the west and northwest portion of the Site but is unconfined beneath the Landfill and south of the Site. Groundwater flow within Aquifer 2 is generally toward the north. Slug test data from Aquifer 2 wells indicate the horizontal hydraulic conductivity ranges from 0.2 to 409 ft/d. The average hydraulic gradient of Aquifer 2 is 0.003 ft/ft. Using an estimated effective porosity of 20%, average flow velocities

calculated by Darcy's Law range from 0.003 to 6.1 ft/d for Aquifer 2.

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D. Water Diversions

The rights for surface-water diversion from Sand Creek exist at two separate locations downstream of the Site. The first diversion point is the proposed Henrylyn Sand Creek Diversion, which is approximately 1.5 miles downstream of the Site. Diversions from this location could reach 250 cubic feet per second of water for direct irrigation and storage in existing and planned reservoirs. The second diversion point is approximately 2 miles downstream of the Site where the Burlington Ditch intersects Sand Creek. A maximum of 250 cubic feet per second of water is appropriated for irrigation and domestic use at this location. According to a representative of the Burlington Ditch Company, water rights along the proposed Henrylyn Sand Creek Diversion or the existing Burlington Ditch have not been exercised to date.

E. Nature and Extent of Contamination

Elevated levels of organic and inorganic contaminants have been detected throughout OU4 in Aquifers 0, 1 and 2. Except for the easten portion of OU4 near the Chemical Sales Company Superfund Site (see Figure 1), low levels of organic contaminants have been detected in upgradient wells used to define background water quality. These include chlorinated VOCs and benzene in Aquifer 0; benzene, toluene, ethylbenzene, and xylene (i.e., BTEX), acetone and chlorobenzene in Aquifer 1 and benzene, toluene ketones and chlorinated VOCs in Aquifer 2. High levels of chlorinated VOCs are present upgradient from the eastern portion of the OU4 study area. These occurrences are believed to be largely the result of releases from past industrial activities at the Chemical Sales Company Superfund Site located upgradient of the OU4 study area. Groundwater remediation at OU1 of the Chemical Sales Company Superfund Site is scheduled to begin during the summer of 1994 and will address this source of VOC contamination. The occurrence of trichloroethene (TCE), tetrachloroethene (PCE), and benzene are representative of the extent of VOC and BTEX in groundwater at OU4. Figures 4, 5, and 6 indicate the extent of TCE, PCE, and benzene contamination at the Site, respectively.

Groundwater in Aquifer 0 contains VOCs; phenols; naphthalene; 1,4-dichlorobenzene; herbicides and elevated levels of antimony, barium, iron, lead, manganese and vanadium, as compared to background concentrations. Most of the organic contaminants such as chlorinated VOCs, ketones, toluene, ethylbenzene, xylene, phenols, 2-methylnaphthalene and naphthalene were detected primarily in the southeastern portion of OU4. Benzene and phthalates were detected throughout Aquifer 0. Elevated levels of styrene, antimony, barium, iron, lead and manganese were detected within and/or downgradient of the 48th and Holly Landfill.

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Contaminants detected in Aquifer 1 include chlorinated VOCs, ketones, BTEX, styrene, phenols, polyaromatic hydrocarbons (PAHs), chlorinated benzene, pesticides, herbicides, aluminum, iron, magnesium, manganese, and sulfate. Elevated levels of organic and inorganic constituents have been detected throughout Aquifer 1, except in the northern and western portions of the aquifer where there are no Aquifer 1 wells. Generally, the highest concentrations of contaminants were detected on the COCC and northern Oriental Refinery properties. Pesticide contamination in groundwater appears to be limited to the same area, which coincides with pesticide contamination in soil at OU5.

Aquifer 2 groundwater contains chlorinated VOCs, ketones, BTEX compounds, phenols, PAHs and elevated levels of antimony, barium, iron, sulfate, lead and manganese. Concentrations of organic contaminants are greatest in two areas: the eastern and southeastern portions of OU4, which are primarily affected by chlorinated VOCs; and the COCC, Oriental Refinery, and LCC properties.

The bedrock aquifers underlying the Site, with the exception of the weathered surface of the Denver Formation, do not appear to have been impacted by groundwater contaminants. The

low-permeability nature of the claystone at the top of the Denver Formation in conjunction with is depth provides protection for the underlying units from dissolved-phase contaminants. The weathered surface at the top of the Denver Formation is characterized by extensive fracturing along bedding planes and behaves hydrologically as part of the overlying alluvial aquifer system.

A plume of LNAPL is present on the groundwater surface beneath the COCC and LCC properties. The LNAPL is located in Aquifer 2 and overlying clay layers, and the thickness of the plume ranges from 1.7 to 4.7 feet. Migration of the LNAPL plume is impeded by the presence of thick, clayey materials. It is estimated that approximately 190,000 gallons of LNAPL occurs as mobile product and another 170,000 gallons of residual LNAPL is present in fine-grained materials. Fingerprinting analysis conducted in 1992 of the LNAPL concluded that it is comprised of two hydrocarbon products: a light naphtha solvent and a diesel-like fuel oil, which increases in age from south to north (along the Aquifer 2 hydraulic gradient). In contrast, hydrocarbon-contaminated soil in the northern portion of the Oriental Refinery property and groundwater northeast of the Site and north of Sand Creek was found to contain only the solvent, while soil in the southern portions of the Oriental Refinery and LCC properties contained only the fuel oil product. The data indicate the presence of at least two LNAPL sources and the northward migration of the LNAPL plume to its current location. Dissolved-phase groundwater contamination associated with the LNAPL includes BTEX, and a plume of tetraethyl lead (TEL).

VI. SUMMARY OF SITE RISKS

CERCLA mandates that EPA protect human health and the environment from current and potential exposures to hazardous substances. Groundwater underlying OU4 was evaluated for potential human health and environmental risks posed by contaminants in several investigations at the Site. These evaluations were baseline assessments and evaluate potential risks associated with exposures to current levels of contamination in the absence of any remedial action at the Site. The following documents describe these risk evaluations:

- 1988 Preliminary Endangerment Assessment (EA) for the Sand Creek Industrial Site, Colorado: This document described a site-wide risk assessment that evaluated risks from contaminated soils, groundwater, surface water, and air at the Site.

- 1993 48th and Holly Street Landfill (OU3) Risk Assessment (RA): This document updated and supplemented the 1988 EA by incorporating new data presented in the OU3 RI. The two media evaluated in this RA were groundwater in the vicinity of the Landfill and landfill gas.

- 1993 Health Evaluation Update: This document was prepared as part of the OU4 RI/FS. It updated and supplemented the 1988 EA by incorporating new data collected during the OU4 RI/FS as well as data collected for the 1993 OU3 RA. Groundwater and the LNAPL plume were the subjects of this evaluation. Results were compared with the previous EA study.

A. Contaminants of Concern

The potential human health and environmental hazards associated with OU4 result from exposure to: contaminated groundwater, the LNAPL plume, and contaminated surface water that could result from the discharge of groundwater to Sand Creek. The LNAPL plume does not appear to be mobile due to its presence within a clay layer that thickens to the north. The LNAPL plume, however, provides a continuous source of mobile, dissolved-phase contaminants such as BTEX and TEL.

The chemicals of concern (COCs) for OU4 indude VOCS, SVOCs, pesticides, and metals. All detected contaminants classified as carcinogens are included in this list. The COCs also include the contaminants likely to present the greatest hazard to human health and the environment based on potential noncarcinogenic adverse effects. EPA combined and evaluated the 37 COCs previously identified in the 1988 site-wide RI, data from the OU4 Free-Phase Plume Investigation, and the COCs identified in the 1993 OU3 RA to determine if it was necessary to continue to use all 37 COCs, or if it was reasonable to retain only a portion of the total number of COCs for the development of a site remedy. For example, some of the 37 COCs were detected in only a few samples, some COCs were present at concentrations at or below normal health-based risk levels,

and some COCs had similar properties, such that one COC could be used to represent other COCs. All COCs were evaluated and 18 were identified as key contributors to risk at the site based on concentrations and toxicity. In addition, 2,4-D and 4,4'-DDT, soil contaminants that are prompting remediation at OU1 and OU5, were included at the request of EPA. The compound chlorophenylmethylsulfone (CPMSO) was also added to the list of COCs at CDH's request after it was detected in urine samples from residents living near the Rocky Mountain Arsenal, located north (downgradient) of OU4. CPMSO was detected in soil and groundwater on the LCC property. Table 1 lists all of the COCS evaluated for OU4 and identifies the 21 key COCs selected for development of remedial alternatives in the OU4 FS.

TABLE 1

CHEMICALS OF CONCERN FOR GROUNDWATER AND LNAPL AT OU4

CHEMICAL OF CONCERN	GROUNDWATER	LNAPL	KEY CHEMICAL OF CONCERN
Volatile Organic Compounds			
Acetone	x		
Benzene	x	x	x
Chlorobenzene	x		
Chloroform	x		x
1,1-Dichloroethene	x		x
1,2-Dichloroethene (total)	x		x
Ethylbenzene	x	x	
Methylene Chloride	x		x
Styrene	x		x
Tetrachloroethene	x		x
Toluene		x	
1,1,1-Trichloroethane	x		
Trichloroethene	x		x
trans-1,2-Dichloroethene	x		x
Vinyl Chloride	x		x
Xylenes		x	
Semi-Volatile Organic Compounds			
Acenaphthene		x	
bis(2-ethylhexyl)phthalate	x		
Dibenzofuran		x	
1,2-Dichlorobenzene	x		
1,4-Dichlorobenzene	x		
Fluoranthene		x	
Fluorene		x	
2-Methylnaphthalene		x	
Naphthalene	x	x	x

Phenanthrene	x
Pyrene	x

TABLE 1

CHEMICALS OF CONCERN FOR GROUNDWATER AND LNAPL AT OU4

CHEMICAL OF CONCERN	GROUNDWATER	LNAPL	KEY CHEMICAL OF CONCERN
Pesticides and Herbicides			
alpha-BHC	x		x
Dieldrin	x		x
2,4-D*	x		x
4,4'-DDT*	x		x
gamma-BHC (Lindane)	x		x
Metals			
Antimony	x		
Arsenic	x		x
Cadmium	x		x
Manganese	x		x
Selenium	x		
Zinc	x		
Other			
CPMSO*	x		x
Tetraethyl Lead		x	x

*2,4-D and 4,4'-DDT, soil contaminants that are prompting remediation at OU1 and OU5, were included at the request of EPA. CPMSO (p-chlorophenylmethylsulfone) was added at the request of CDH.

B. Exposure Assessment

Exposure pathways and receptors were identified for OU4 in a conceptual model developed for the Site. Potential release mechanisms associated with OU4 are discharge of groundwater to surface water and pumping groundwater for residential, agricultural, or industrial use.

A 1990 report prepared by TCHD for EPA and CDH contains the most current information on OU4 area water use. The report summarizes the findings of a door-to-door well inventory and information survey. The survey encompassed an area bounded by Sand Creek on the north, Interstate 70 on the south, Quebec Street on the east, and Colorado Boulevard on the west. (This survey area extends beyond the boundaries of OU4.) The survey supported CDH and EPA efforts to identify potential receptors of groundwater contaminated by several sources, including sources at the Site. TCHD contacted property owners to determine the number, location, depth, construction details, and current use of wells in the survey area.

TCHD obtained information on water use from 419 of the 420 properties in the survey area. SACWSD and DWB serve most of the water users in the survey area. However, the survey identified 23 private wells, with nine completed in the shallow alluvium. Data regarding the depth of nine wells were unavailable. Four wells identified as deep ranged from 560 to 1600 feet depth and, thus, are not in the shallow alluvial aquifers. Two of the deep wells provided water for drinking. No contamination of the deep bedrock aquifers at the Site has been observed in the studies performed to date.

Of the wells completed in the shallow alluvium, only five are in use. Three are used for irrigation and one as a seasonal water supply for livestock. The remaining well, located at a business on Oriental Refinery property, provides water for a sanitary waste system. The potential for human exposure to groundwater contaminants resulting from these uses is unknown. These wells will be sampled and evaluated as part of the OU4 monitoring program to determine the need for future action. EPA and CDH will notify and provide recommendations to the users if contamination is detected.

Since current use of shallow alluvial groundwater is limited to agricultural and wastewater uses, exposures for the current scenario were not quantified. Domestic use of contaminated groundwater and exposure to the LNAPL, however, were evaluated for potential future exposure scenarios. Exposure pathways evaluated quantitatively were ingestion of groundwater, and inhalation of volatile contaminants during showering. Dermal exposure to contaminants in groundwater during showering, and exposure to surface water contaminants for aquatic biota were evaluated qualitatively.

Estimated exposures were evaluated for the average case and the reasonable maximum case. The arithmetic mean concentration of contaminants in groundwater was used for the average case. Maximum contaminant concentrations detected in groundwater were used for the reasonable maximum case. A resident weighing 70 kilograms was assumed to ingest 2 liters of water per day for 70 years. The 70 kilogram resident was also assumed to be exposed to contaminants volatilized from a 10-minute shower and to remain in the shower room for 5 minutes longer for a total exposure time of 15 minutes. A volatilization model developed by Foster and Chrostowski was used to estimate air concentrations. These were the same basic assumptions used in the 1988 EA, and were developed before current guidance regarding the use of reasonable maximum exposures (RMEs) was issued. Results from the 1988 report provide a conservative estimate of risks that are essentially equivalent to risks calculated with current guidance.

C. Risk Characterization

Potential health risks to humans are expressed in two ways: carcinogenic (cancer causing) and noncarcinogenic. For carcinogens, it is assumes that there is no safe dose, but that the risk of cancer is reduces as the dose is decreased. Slope factors (SF) are used to estimate excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. Excess lifetime cancer risk is determined by multiplying the intake by the SF. These risks are probabilities and are generally expressed as excess cancer risks. An excess lifetime cancer risk indicates the chance, over and above the background average risk (approximately one in four), that an individual will develop cancer as a result of exposure to a carcinogen over a 70-year lifetime under specific exposure conditions. In determining the need for remedial action at Superfund sites, EPA guidance states that the total excess cancer risk for all

contaminants must fall below the range of 1 chance in 10,000 (1E-04) to 1 chance in 1 million (1E-06).

Noncarcinogenic risks are calculated by assuming there is a dose below which no adverse health effects will occur. This level is called the reference dose (RfD) and is used to estimate the hazard quotient (HQ) associated with the potential exposure to noncarcinogens. HQs are determined by calculating the ratio of the estimated intake level to the RfD. A hazard index (HI) can be generated by adding the HQs for all chemicals with similar target organs or critical effects within a medium, and by adding HQs across all media to which a population may reasonably be expected to be exposed. The HI provides a useful reference point for evaluating the potential significance of multiple contaminant exposures within a single medium or across media. An HI of 1 is identified in the NCP as a Superfund site remediation goal.

Risks estimated for OU4 indicate that actual or threatened releases of hazardous substances from OU4 groundwater, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. Current and potential future human health risks as well as environmental risks attributable to OU4 are discussed below:

1. Current Human Health Risks

Currently, shallow alluvial groundwater is not used for domestic purposes. There are five wells completed in the shallow alluvium in the OU4 vicinity and they are used for agricultural or sanitary waste purposes. Estimates of current risks were not calculated due to the lack of sampling data for these wells and the absence of completed exposure pathways. As mentioned previously, these wells will be sampled and evaluated as part of the OU4 groundwater monitoring program, and EPA and CDH will notify and provide recommendations to the users if contamination is detected.

2. Future Human Health Risks

The contaminants of concern and exposure factors used to calculate risks for the 1993 OU3 RA and 1993 Health Evaluation Update were identical to those used in the 1988 site-wide RI and, therefore, the risk values generated in these three evaluations can therefore be directly compared. This comparison illuminates differences and similarities in the contaminant and risk profile for shallow alluvial groundwater in 1988, 1991, and 1992. However, there were significant differences in sample size for each aquifer and each investigation, which potentially affects the results (i.e., fewer samples and fewer wells sampled may result in data that do not represent aquifer contamination). In addition, only some of the samples collected in 1991 were analyzed for pesticides, and the 1992 investigation did not include analysis for metals. The 1992 Aquifer 0 data are considered inadequate for risk evaluation because of the small sample size. Similarly, the data collected in 1991 are considered inadequate to evaluate the risks associated with Aquifer 1.

The calculated total risks for individual aquifers and specific data bases are presented in Table 2 and are all based on the maximum detected concentration from the sample data for each aquifer, rather than on an average concentration. Generally, the 1991 and 1992 data indicate risks similar to those calculated from data collected for the 1988 site-wide RI. The risk values indicate that groundwater in all three aquifers, and the LNAPL plume have total excess cancer risks (ranging from 1E-02 to 1E-03) that are above EPA's acceptable risk range.

The greatest risks are associated with ingestion of groundwater. However, inhalation of VOCs during showering contributes significantly to risk in several cases. The primary contaminants contributing to cancer risk in groundwater are arsenic, benzene, and vinyl chloride, all classified as known human, or "Class A", carcinogens. For the LNAPL, benzene alone contributes the total cancer risk of greater than 1 in 100 (1E-02) when ingestion is considered. The high concentrations of contaminants in the LNAPL make ingestion unlikely due to odor, bad taste, and visible contamination. The LNAPL is likely to be acutely toxic. It should be noted that the difference in risks calculated for the individual aquifers versus the OU4 collective data is primarily attributable to the exclusion of benzene and other petroleum-related compounds from

the aquifer-by-aquifer analysis in the 1988 EA.

The primary contributors to noncarcinogenic risk in groundwater are the chlorinated solvents tetrachloroethene and 1,2-dichloroethene (critical effects: liver and kidney damage), the metals manganese (critical effect: neurological disorders) and arsenic (critical effect: skin lesions), the polyaromatic hydrocarbon naphthalene (critical effect: interference with developmental weight gain), and the insecticide dieldrin (critical effect: liver damage). Tetraethyl lead (critical

TABLE 2

TOTAL CARCINOGENIC AND NONCARCINOGENIC RISKS CALCULATED FOR POTENTIAL FUTURE EXPOSURE TO OU4 CONTAMINATION.

EXPOSURE PATHWAY-TOTAL RISKS	AQUIFER 0			AQUIFER 1			AQUIFER 2			AQUIFERS 0 & 1	
	1988	1991	1992	1988	1991	1992	1988	1991	1992	1991	1992
Ingestion of Groundwater											
- Total Cancer Risk	4E-3	4E-3	-	9E-3	-	3E-5	2E-3	8E-4	3E-3	3E-2	1E-2
- Hazard Index	2	3	-	5	-	0.06	4	4	1	44	3
Inhalation of Volatile COCs in Groundwater While Showering											
- Total Cancer Risk	9E-4	3E-3	-	7E-4	-	5E-7	4E-4	1E-3	4E-4	-	-
- Hazard Index	-	0.9	-	1	-	0.03	0.4	0.05	0.4	-	-

Note: The year indicated refers to a values reported in a specific risk assessment report or values calculated from a specific data base. 1988 = Risks calculated using 1986 and 1987 RI data and reported in the 1988 Preliminary Endangerment Assessment. 1991 and 1992 = Risks calculated using groundwater data collected in 1991 and 1992.

Data collected in 1991 and 1992 are considered to be too limited to evaluate risks associated with Aquifer 1 and Aquifer 0, respectively.

effect liver damage and central nervous system disorders) is the primary contributor to noncarcinogenic risk for the LNAPL.

3. Environmental Risks

The potential hazards to environmental receptors were qualitatively evaluated in the 1988 EA and the 1993 OU3 RA. Terrestrial and aquatic habitats present at the Site were described and individual species known to occur in the vicinity were identified. No federal or state threatened or endangered plant or animal species are known to be present on the Site.

The likelihood of exposure of terrestrial receptors to COCs in groundwater is considered remote because groundwater is not accessible except at the point of discharge into a marsh near the landfill. The maximum concentrations of COCs in surface water collected at the marsh were compared to federal ambient water quality criteria (AWQC) and state water quality standards for protection of aquatic life. Maximum surface water concentrations at the marsh were lower than AWQC and state standards for all COCs having an established standard. These results agreed with previous similar comparisons for the 1988 EA. Because of the low potential for exposure to groundwater contaminants for terrestrial receptors and the low concentrations of contaminants found in surface water, environmental risks are currently expected to be minimal.

VII. DESCRIPTION OF ALTERNATIVES

In the OU4 FS, a range of options were developed for addressing groundwater and LNAPL contamination at OU4. Ten remedial alternatives were retained for OU4 following the development, screening, and detailed analysis of alternatives in the FS. EPA decided to include alternatives involving containment or full-scale treatment of the LNAPL plume because: (1) the LNAPL plume poses a potential threat to human health or the environment through discharge to Sand Creek, the Denver Metro sanitary sewer lines, and downgradient wells; (2) the LNAPL plume represents a continual source of contaminants and therefore affects groundwater treatment options; and (3) the presence of the LNAPL interferes with operation of the soil vapor extraction (SVE) system constructed for remediation of OU1. As discussed previously, petroleum contamination is generally excluded from CERCLA investigations due to the Petroleum Exclusion, which exempts pure product from CERCLA response actions. However, EPA has response authority to address the LNAPL at OU4 because the product is mixed wtth hazardous substances. Removal of the recoverable portion of the LNAPL plume beneath the COCC property would occur under OU1 remedial action, but it is considered to be a component of the alternatives developed for OU4 since many of the treatment options for OU4 would contain or treat the LNAPL as well as dissolved-phase groundwater contamination.

Five-year site reviews would be conducted for all alternatives developed for OU4. Except for the "No-Action" alternative, each alternative also includes the following common elements:

Groundwater and Surface Water Monitoring - Existing and future groundwater monitoring wells (approximately 16) would be sampled and analyzed periodically throughout OU4 to assess the effectiveness of the selected alternative and changes in natural conditions. Monitoring points would be located upgradient of the Site (to detect contamination entering the Site), within the LNAPL plume (to track movement of the LNAPL), downgradient from OU4 (to detect dissolved-phase and LNAPL plume migration off site), within Sand Creek (to assess the possible discharge of contaminated groundwater to surface water), and immediately north of Sand Creek (to detect any migration of contaminants under the creek). Samples will initially be collected quarterly, but may be collected less frequently if data indicate that site conditions are not changing significantly on a quarterly basis. In addition, the five private wells that are completed in the shallow alluvium in the vicinity of OU4 will be sampled and evaluated as part of the OU4 groundwater monitoring program. EPA and CDH will notify and provide recommendations to the users if contamination is detected.

Institutional Controls - EPA and CDH will coordinate with local officials and property owners, and will request the use and implementation of institutional controls at the Site. Zoning restrictions, including recommendations against well usage for domestic purposes, will be proposed in order to minimize potential future human exposure to contaminated groundwater underlying the site. These objectives are already achieved in part through state advisories against the construction of water wells in areas with known contamination. Additional

institutional controls that may be implemented as necessary include subdivision regulations, building permits, recording requirements, state statutes, local ordinances, and deed restrictions and notices implemented by current property owners.

Alternative 1: No Action

The Superfund program requires that the "No-Action" alternative be considered at every site. The No Action alternative establishes a baseline for comparison of other alternatives. Under this alternative, EPA would not remove, treat, or contain the LNAPL plume or contaminated groundwater. However, groundwater contamination levels may be reduced over the long-term through natural attenuation. EPA could set specific action levels and take remedial action at OU4 in the future if warranted by a change in site conditions.

Alternative 2: Monitoring and Institutional Controls

As with Alternative 1, EPA would take no action to remove, treat, or contain the LNAPL plume or contaminated groundwater. However, steps would be taken to limit human exposure to contaminated groundwater through the implementation of local institutional controls. In addition, monitoring of groundwater and surface water at the Site would be performed to evaluate changes in site conditions. Natural attenuation processes would reduce contaminant concentrations in groundwater over the long-term. As with Alternative 1, EPA could set specific action levels and implement remedial action in the future if warranted by a change in site conditions.

Alternative 3: Monitoring and Institutional Controls with LNAPL Remova1

Alternative 3 is similar to Alternative 2, with the addition of removal of the LNAPL plume. The principal elements of this alternative are:

- Dual vapor extraction (DVE) wells would be installed in the LNAPL plume area. LNAPL vapors and liquids removed from the subsurface would pass through an air/liquid separator, and the resulting liquid stream would flow through an oil/water separator to recover free-phase LNAPL. Recovered LNAPL would be transported off site to a recycling facility. Water from the oil/water separator would be transported to an on-site groundwater treatment facility. LNAPL vapors from the air/liquid separator would be transported by pipeline to the soil vapor extraction (SVE) system in operation at OU1 for treatment by the existing catalytic oxidation unit.

- Water received at the treatment facility from the DVE system oil/water separator would first be pre-treated for metals removal using chemical precipitation followed by sedimentation. Groundwater pretreatment for metals is necessary to prevent potential fouling and clogging of the air stripper. The water would then pass through an air stripper where volatile contaminants would be removed. In particular, air stripping would remove vinyl chloride and methylene chloride which would tend to pass through the granular activated carbon (GAC) unit. Treatment of the off-gas from the air stripper may be required depending upon the level of emissions. Liquid phase GAC would follow as the final treatment process, however, a detailed engineering evaluation could result in a re-sequencing of the air stripping and GAC treatment processes. Spent GAC would be regenerated off site.

- Treated groundwater would be injected on site, upgradient of the extraction wells. EPA permitting (SDWA UIC Class 5 permit) and testing prior to injection would occur as necessary.

Alternative 4: Limited Containment of LNAPL using a Cutoff Wall

Alternative 4 is similar to Alternative 3 with the exception that the LNAPL plume would be contained, rather than removed. The principal elements of this alternative are:

- A vibrating beam wall would be constructed along the northern and eastern edges of the LNAPL plume (Figures 7 and 8) to contain and prevent further migration of the LNAPL plume and associated dissolved-phase groundwater

contamination, and therefore prevent further degradation of the groundwater.

- A series of extraction wells would be constructed upgradient and adjacent to the vibrating beam wall. Groundwater would be pumped, only as necessary, to reduce the pressure and prevent flow around the wall.

- Extracted groundwater would be transported by pipeline to an on-site treatment facility.

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- Groundwater would be treated to reduce concentrations of metals and organic compounds, as described under Alternative 3. Any LNAPL withdrawn with the groundwater would be separated out with an oil/water separator prior to groundwater treatment and be transported off site to a recycling center.

- Treated groundwater would be injected on site, downgradient of the vibrating beam wall. EPA permitting (Safe Drinking Water Act (SDWA) Underground Injection Control (UIC) Class 5 permit) and testing prior to injection would occur as necessary.

- No additional removal, treatment or containment of the groundwater would occur except for the removal and treatment necessary to maintain the integrity and effectiveness of the containment system.

Alternative 5: Localized Pump and Treat with LNAPL Containment and Groundwater Treatment by GAC and Air Stripping

In this alternative, as well as the following alternatives dissolved phase contaminants in groundwater are specifically targeted for remediation. The LNAPL plume is contained as described in Alternative 4. The major elements of this alternative are:

- A series of extraction wells would be constructed within the localized extent of groundwater remediation area defined on Figures 7 and 8.

- Limited containment of the LNAPL plume (vibrating beam wall), as described in Alternative 4, would be implemented in conjunction with the pump and treat system.

- Groundwater would be pumped and transported by pipeline to an on-site treatment facility. The contaminated groundwater would be treated to reduce levels of metals and organic compounds, as described under Alternative 3.

- Treated groundwater would be injected downgradient of the vibrating beam wall. EPA permitting (SDWA UIC Class 5 permit) and testing prior to injection would occur as necessary.

Alternative 6: Localized Pump and Treat with LNAPL Removal and Groundwater Treatment by GAC and Air Stripping

Alternative 6 is identical to Alternative 5 with the exception that the LNAPL plume would be removed, rather than contained. The major components of this alternative are:

- A series of extraction wells would be constructed within the localized area defined on Figure 7. Groundwater would be pumped and transported by pipeline to an on-site treatment facility, where it would be treated to reduce concentrations of metals and organic compounds, as described under Alternative 3.

- DVE wells would be installed in the LNAPL plume area. LNAPL vapors and liquids removed by the DVE wells would pass through an air/liquid separator, and the resulting liquids stream would flow through an oil/water separator to recover free-phase LNAPL. Recovered LNAPL would be transported off site to a recycling facility. Water from the oil/water separator would be transported to

an on-site groundwater treatment facility where it would be treated with groundwater removed by the localized extraction system. LNAPL vapors from the air/liquid separator would be transported by pipeline for treatment by the catalytic oxidation unit in operation at the OU1 SVE system.

- Treated groundwater would be injected back into the shallow aquifer. EPA permitting (SDWA UIC Class 5 permit) and testing prior to injection would occur as necessary.

Alternative 7: Localized Pump and Treat with LNAPL Containment and Groundwater Treatment by UV Oxidation

Alternative 7 is similar to Alternative 5 with the primary difference being the groundwater treatment method. This alternative would use UV oxidation, rather than air stripping and GAC filtration for treatment of contaminated groundwater. Since UV oxidation is an innovative and unproven technology, a treatability study would be performed prior to implementation of Alternative 7 to verify the effectiveness of the treatment process at OU4. The principal components of Alternative 7 are:

- A series of extraction wells would be constructed within the localized extent of groundwater remediation area defined on Figures 7 and 8.

- Limited containment of the LNAPL plume (vibrating beam wall), as described in Alternative 4, would be implemented in conjunction with the pump and treat system.

- Groundwater would be pumped and transported by pipeline to an on-site treatment facility.

- Any LNAPL withdrawn with the groundwater would be separated out with an oil/water separator and transported off site to a recycling center. The groundwater treatment process would consist of pre-treatment for metals using chemical precipitation followed by sedimentation. The water would then pass through a UV oxidation unit to remove VOCs. If ozone is used in the treatment process, off-gas from the treatment process would pass through an ozone decomposer before air venting.

- Treated groundwater would be injected downgradient of the vibrating beam wall. EPA permitting (SDWA UIC Class 5 permit) and testing prior to injection would occur as necessary.

Alternative 8: Localized Pump and Treat with LNAPL Removal and Groundwater Treatment by UV Oxidation

This alternative is similar to Alternative 7 in that it includes a localized pump and treat system and the use of UV oxidation in treating contaminated groundwater. The main difference is that Alternative 8 provides for removal of the LNAPL plume, rather than containment. As with Alternative 7, a treatability study would need to be performed prior to implementation of the alternative to verify the effectiveness of UV oxidation in treating contaminated groundwater at OU4. The primary elements of this alternative include:

- A series of extraction wells would be constructed within the localized area defined on Figures 7 and 8. Groundwater would be pumped and transported by pipeline to an on-site treatment facility.

- A DVE system would be installed in the LNAPL plume area and operated as described under Alternative 3.

- Water received at the treatment facility from both the groundwater extraction system and the dual vapor extraction system would treated as described under Alternative 7.

- Treated groundwater would be injected back into the shallow aquifer. EPA permitting (SDWA UIC Class 5 permit) and testing prior to injection would

occur as necessary.

Alternative 9: Site-Wide Pump and Treat for Total Groundwater Restoration with LNAPL Containment

Alternative 9 consists of the same basic elements as Alternative 5 except that the scope of the remedial action is more comprehensive. In this alternative a site-wide groundwater extraction system would be constructed, rather than focusing only on the most highly contaminated area near the COCC and LCC properties.

- A series of extraction wells would be constructed throughout the entire site (see site-wide extent of groundwater remediation on Figure 7).
- Limited containment of the LNAPL plume (vibrating beam wall), as described in Alternative 4, would be implemented in conjunction with the pump and treat system.
- Groundwater would be pumped and transported by a conveyance system (pipelines) to an on-site treatment facility. Groundwater treatment for metals and organic compounds would occur as described in Alternative 3.
- Treated groundwater would be injected downgradient of the vibrating beam wall. EPA permitting (SDWA UIC Class 5 permit) and testing prior to injection would occur as necessary.

Alternative 10: Site-Wide Pump and Treat for Total Groundwater Restoration with LNAPL Removal

This alternative is similar to Alternative 9 in that site-wide remediation would occur, but the LNAPL plume would be removed rather than contained. Following completion of the remedial action, the Site would be available for unrestricted commercial and/or industrial use. The principal components of this alternative are:

- A series of extraction wells would be constructed throughout the entire Site, as indicated in Figure 7. Groundwater would be pumped and transported by pipeline to an on-site treatment facility.
- A DVE system would be installed in the LNAPL plume area, as described in Alternative 3.
- Contaminated water received at the treatment facility from both the groundwater extraction system and the dual vapor extraction system would treated for metals and organic compounds as described under Alternative 3.
- Treated groundwater would be injected back into the shallow aquifer. EPA permitting (SDWA UIC Class 5 permit) and testing prior to injection would occur as necessary.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, alternatives developed for OU4 are evaluated and compared to each other using the nine evaluation criteria required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 CFR § 300.430) to identify the alternative that provides the best balance among the criteria. The relative performance of the alternatives is summarized by highlighting the key differences among the alternatives in relation to the following criteria:

1. Overall Protection of Human Health and the Environment;
2. Compliance with Applicable, or Relevant and Appropriate Requirements (ARARs);
3. Long-Term Effectiveness and Permanence;
4. Reduction of Toxicity, Mobility, or Volume Through Treatment;
5. Short-Term Effectiveness;
6. Implementability;
7. Cost;
8. State Acceptance; and

9. Community Acceptance.

The NCP defines the first two criteria as threshold criteria which must be met by the alternative. The succeeding five criteria, termed balancing criteria, form the primary criteria on which the detailed analysis of alternatives is based. The last two criteria are modifying criteria and were evaluated after public comment on the Proposed Plan is received.

A. Overall Protection of Human Health and the Environment

This criterion assesses the protection afforded by each alternative, considering the magnitude of the residual risk remaining at the Site after the remedial action has been completed. Protectiveness is determined by evaluating how site risks from each exposure route are eliminated, reduced, or controlled by the specific alternative. The evaluation also takes into account short-term or cross-media impacts that result from implementation of the alternative remedial activity.

Although groundwater in the area is classified as a potential drinking water supply by the State of Colorado, there is no unacceptable current health-risk due to ingestion, inhalation, or skin contact with contaminated groundwater because water for residential use is provided through treated water from either the DWD or SACWSD.

Alternative 1O is the most protective of human health and the environment and would allow future commercial/industrial use of the Site without engineering or institutional controls and without limitations on the exposures for human and environmental receptors. Alternative 1 provides the least protection to human health and the environment of the ten alternatives. Contaminant levels would only be reduced through natural attenuation under Alternatives 1 and 2, and the LNAPL and dissolved contaminant plumes are not contained or treated. Remedial action could be taken under Alternatives 1 and 2, however, if future information indicates that the contamination migrates to either Sand Creek or the underlying aquifers. Alternatives 2 through 10 would provide overall protection to human health through the use of institutional controls which would limit human exposure to contaminated media. Migration of the LNAPL plume which could potentially threaten Sand Creek, Metro sanitary sewer lines, or downgradient wells is prevented by the installation of a vibrating beam wall in Alternatives 4, 5, 7, and 9. However, Alternatives 3, 6, 8, and 10 would provide relatively greater protection from potential effects from exposure to the LNAPL by removing the recoverable LNAPL from the Site, rather than containing it. Site-wide groundwater remediation included in Alternatives 9 and 10 would provide relatively greater protection of human health and the environment at OU4 than the localized groundwater remediation proposed under Alternatives 5 through 8.

B. Compliance with ARARs

Section 121(d) of SARA mandates that for all remedial actions conducted under CERCLA, cleanup activities must be conducted in a manner that complies with ARARs, or if ARARs cannot be attained a justifiable waiver must be obtained. The NCP and SARA have defined applicable requirements and relevant and appropriate requirements as follows:

- Applicable requirements are those federal and state requirements that would be legally applicable, either directly, or as incorporated by a federally authorized state program.

- Relevant and appropriate requirements are those federal and state requirements that, while not legally "applicable," are designed to apply to problems sufficiently similar to those encountered at CERCLA sites that their application is appropriate. Requirements may be relevant and appropriate if they would otherwise be "applicable," except for jurisdictional restrictions associated with the requirement.

- Other requirements to be considered are federal and state non-regulatory requirements, such as guidance documents or criteria. Advisories or guidance documents do not have the status of potential ARARs. However, where there are no specific ARARs for a chemical or situation, or where such ARARs are not sufficient to be protective, guidance or advisories should be identified and used to ensure that a remedy is protective.

Federal and state ARARs which must be considered include those that are: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs govern the extent of site cleanup in terms of actual treatment levels. Location-specific ARARs govern natural features such as wetlands and floodplains, and man-made features such as archeological and historic areas. Action-specific ARARs are technology- or activity-based requirements that set restrictions on particular kinds of actions at CERCLA sites.

Table 3 summarizes the potential ARARs and guidance, advisories, and criteria to be considered (TBCs) for OU4. All alternatives would likely comply with pertinent chemical-, action- and location-specific ARARs. Alternatives which involve withdrawal, treatment, and injection of groundwater (Alternatives 3 through 10) will be required to achieve Safe Drinking Water Act Maximum Contaminant Levels (SDWA MCLs) and/or state standards prior to groundwater injection. Contaminated groundwater attributable to the Site would also be required to meet SDWA MCLs and/or state groundwater standards at the downgradient (i.e., northern) Site boundary. There are no chemical-specific ARARs for Alternative 1 since no activity would occur.

Wells installed for monitoring and/or extraction and injection systems in Alternatives 2 through 10 would be subject to the requirements of the Colorado Department of Natural Resources, State Engineer's Office. Additional action-specific ARARs that Alternatives 3 through 10 must comply with include: state air regulations for emissions from the LNAPL and groundwater treatment systems; the Hazardous Materials Transportation Act (HMTA) and the Resource Conservation and Recovery Act (RCRA) for the off-site transport of treatment residuals; and RCRA for waste disposal, reuse, and recycling. There are no action-specific ARARs for Alternative 1 since no activity would occur.

Compliance with location-specific ARARs for alternatives that include the vibrating beam wall, extraction and injection systems, or treatment facilities (i.e., Alternatives 3 through 10) would depend on the location of these components. However, no protected properties have been identified in the immediate vicinity of OU4.

Guidance regarding ambient air levels of toxic air pollutants (National Ambient Air Quality Standards, NAAQSs) should be considered for designing air pollution controls for the Site. The EPA Reference Concentrations and Slope Factors would be used to calculate the hazard indices and the risk levels. The State of Colorado considers the

TABLE 3
SELECTED POTENTIAL ARARs AND TBCs FOR
OPERABLE UNIT 4, SAND CREEK INDUSTRIAL SUPERFUND SITE

Regulation	Citation	Comments
	ARARs	
Resource Conservation and Recovery Act	42 USC § 6901 40 CFR Parts 260-268	ARAR if Remedial Action involves hazardous waste or sufficiently similar material.
Safe Drinking Water Act - Underground Injection Control Regulations	42 USC § 300 (g) 40 CFR Parts 144 - 147	ARAR if Remedial Action includes injection of ground water.
Primary Drinking Water Regulations	42 USC § (300) (f) 40 CFR Part 141	Includes final maximum contaminants levels (MCLs) and MCL goals (MCLGs) greater than zero. May serve as treatment level prior to injection.
Colorado Classification and Water Quality Control Act	5 CCR 1002-8	May serve as clean-up and/or treatment levels. Contains allowance for variance at CERCLA sites.
Colorado Basic Standards for Groundwater	5 CCR 1002-8	May serve as clean-up and/or treatment levels. Contains allowance for variance at CERCLA sites.
Hazardous Materials Transportation Act	49 § 1801 et. seq. 49 CFR Parts 107, 171, 172	ARAR if hazardous materials are transported off site.
Clean Air Act	42 USC § 7412 et. seq.	
! NSPS	40 CFR Part 60	ARAR if Remedial Action involves regulated new source(s).
! PSD requirements	40 CFR Part 52	ARAR if RA involves major new source(s) of SO2 or NO2.
! NESHAPs	40 CFR Part 61	ARAR if RA involves emission of a regulated pollutant from a regulated source.
Colorado Air Pollution Control Regulations	5 CCR 1001-1 et. seq.	

!	Regulation 1	5 CCR 1001-3	Regulations emission of SO2, particulates and smoke.
!	Regulation 2	5 CCR 1001-4	Regulates odorous emissions from a single source.
!	Regulation 3	5 CCR 1001-5	Sets permitting requirements, only substantive requirements may be ARARs.
!	Regulation 6	5 CCR 1001-8	Sets performance standards for new emissions sources.
!	Regulation 7	5 CCR 1001-9	Regulates VOC emissions.
Colorado Revised and Amended Rules and Regulations of the Board of Examiners of Water Well Construction and Pump Installation Contractors		2 CCR 402-2	ARAR for groundwater monitoring well installation and abandonment activities.
Executive Order on Floodplain Management		Executive Order 11988 40 CFR Part 6.302(b)	ARAR if designated floodplain is affected.
Executive Order on Protection of Wetlands		Executive Order 11990 40 CFR Part 6.302(a)	ARAR if designated wetland is affected.

TABLE 3
SELECTED POTENTIAL ARARs AND TBCs FOR
OPERABLE UNIT 4, SAND CREEK INDUSTRIAL SUPERFUND SITE

Regulation	Citation	Comments
	TBCs	
Clean Air Act- National Ambient Air Quality Standards (NAAQS)	42 USC § 7401 40 CFR Part 50	ARAR if more than 250 tons/year of SO2, or NO2, or 100 tons/year of PM-10, CO or O3 are emitted from RA treatment facility.
Massachusetts Allowable Ambient Levels	Code of Massachusetts Regulations Title 310 § 6.04	The State of Colorado considers these air quality standards a TBC.
Safe Drinking Water Act National Primary Drinking Water Standards-Proposed	42 USC § 300 (f) 40 CFR Parts 141.11 and 141.16	May serve as clean-up level for treating groundwater prior to injection.
Colorado Interim Organic Pollutant Standards	5 CCR 1002-8	May serve as clean-up level for treating groundwater prior to injection.
Superfund LDR Guide #5	EPA OSWER Directive 9347.3-05FS	Guidance for on-site disposal of hazardous waste.
Superfund LDR Guide #7	EPA OSWER Directive 9347.3-08FS	Guidance for on-site disposal of hazardous waste.
EPA Guidance Document	EPA OSWER Directive 9355.0-28	Guidance for control of emissions from air strippers at Superfund sites.
CERCLA Petroleum Exclusion Clause	42 USC § 101 (4) 42 USC § 104 (a)	Limits CERCLA authority and funding for removal and treatment of petroleum product.
Adams County Zoning Regulations	-	May affect institutional controls.

Massachusetts Ambient Air Level standards as important guidance. EPA has issued a policy statement regarding air emission controls for air strippers located in ozone non-attainment areas and believes that this policy is a TBC because Denver is an ozone non-attainment area (OSWER Directive 9355.0-28). Other TBCs identified for OU4 are the CERCLA Petroleum Exclusion, and EPA guidance regarding land disposal restrictions.

C. Long-Term Effectiveness and Permanence

The focus of this criterion is to determine the effectiveness of each alternative with respect to the risk posed by treatment of residuals and/or untreated wastes after the cleanup criteria have been achieved. Several components were addressed in making the determinations, including:

- Magnitude of residual risk from the alternative;
- Likelihood that the alternative will meet process efficiencies and performance specifications;
- Adequacy and reliability of long-term management controls providing continued protection from residuals; and
- Associated risks in the event the technology or permanent facilities must be replaced.

Alternative 10 would provide the greatest degree of long-term effectiveness since contaminants would be permanently removed from the Site and no residual risks would remain. Alternatives 2 through 9 would be effective at limiting contact with and ingestion of contaminated groundwater in the long term provided that institutional controls are effective. The No-Action alternative would not provide long-term effectiveness. Alternatives 3 through 1O effectively prevent the spread of the LNAPL plume and a portion of the dissolved contaminant plumes in the long term provided the integrity of the vibrating beam wall is maintained or the dual extraction system operates satisfactorily. The long-term effectiveness of groundwater remediation in Alternatives 5 through 10 depends upon continual remediation since re-contamination of the site would occur due to upgradient sources once the OU4 pump and treat system was shut down.

D. Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion evaluates the ability of the alternatives to significantly achieve reduction of the toxicity, mobility, or volume of the contaminants or wastes at the site through treatment. The criterion is a principal statutory requirement of CERCLA. This analysis evaluates the quantity of contaminants treated and destroyed, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction, the degree to which the treatment will be irreversible, the type and quantity of residuals produced, and the manner in which the principal threat will be addressed through treatment. The risk posed by residuals is considered in determining the adequacy of reduced toxicity and mobility achieved by each alternative.

Alternative 10, followed by Alternative 9, provide the greatest reduction in toxicity, mobility and volume of contamination through total restoration of groundwater (versus localized groundwater remediation under Alternatives 5 through 8) at the Site. Removal of the LNAPL plume in Alternatives 3, 6, 8, and 10 would reduce the volume of LNAPL, rather than simply reduce its mobility as would be accomplished with the vibrating beam wall in Alternatives 4, 5, 7, and 9. No reduction in contaminant toxicity, mobility, or volume, other than by natural processes, would occur under Alternatives 1 and 2. Alternative 4 reduces the mobility of the LNAPL plume, but would provide only a minimal reduction in contaminant toxicity and volume by treatment only of groundwater extracted to maintain the integrity of the vibrating beam wall. Upgradient sources would provide a continuous source of contaminants (LNAPL and VOCs) to the OU4 area under all the alternatives.

E. Short-Term Effectiveness

The short-term effectiveness of each alternative was assessed based on the risk associated with the implementation of the remedial action to the community, workers, and environment and the time required to achieve the response objectives. Measures to mitigate releases and provide

protection are central to this determination.

All of the alternatives except for Alternative 1 would provide a similar degree of short-term effectiveness by protecting the community, workers, and environment through adequate preventative measures. These preventative measures include items such as establishing exclusion zones during remedial activities, use of personal protective equipment for onsite workers, and dust control practices. The greater scope of construction activities associated with site-wide groundwater remediation in Alternatives 9 and 10 would result in slightly higher short-term risks as compared with the localized treatment or containment actions included in the other alternatives. However, standard engineering controls and adherence to standard health and safety practices would minimize potential adverse short-term impacts. Alternative 1 would provide the least amount of short-term effectiveness. The time until the response objectives are achieved for Alternatives 5 through 10 is unknown because the duration of remediation at OU4 is largely dependent on removing upgradient sources of contamination (LNAPL and upgradient contaminated groundwater). For costing purposes, it was assumed that at least 30 years would be necessary.

F. Implementability

This criterion analyzes technical and administrative feasibility, and the availability of services and materials. Technical feasibility assesses the difficulty of construction or operation of a particular alternative and uncertainties associated with process technologies. The reliability of the technologies based on the likelihood of technical problems that would lead to project delays is critical in this determination. The ability to monitor the effectiveness of the alternative is also considered.

Administrative feasibility assesses the ease or difficulty of obtaining permits or rights-of-way for construction. Availability of services and materials evaluates the need for off-site treatment, storage, or disposal services, and the availability of such services.

Necessary equipment, specialists, and additional resources are also evaluated in determining the ease by which these needs could be fulfilled.

All of the alternatives under consideration, except those involving site-wide remediation (Alternatives 9 and 10), are both technically and administratively feasible, although implementation of Alternative 1 is unlikely from an administrative standpoint. It is doubtful that regulatory agencies or the public would accept a No Action alternative for OU4. Alternative 2 is the easiest to implement because relatively little construction would be involved. Alternatives 3 through 6, 9 and 10 involve the utilization of readily available, proven technologies. Alternatives 7 and 8 would be more difficult to implement because they incorporate an innovative, unproven technology (i.e., UV oxidation) requiring a treatability study. The larger scope of the remedial effort under Alternatives 9 and 10 and the presence of upgradient contaminant sources would make implementation of these alternatives much more difficult than that associated with alternatives involving localized or no groundwater remediation.

G. Cost

Alternatives are evaluated for cost in terms of both capital costs and long-term O&M costs necessary to ensure continued effectiveness of the alternatives. Capital costs include the sum of the direct capital costs (materials, equipment, labor, land purchases) and indirect capital costs (engineering, licenses, or permits). Long-term O&M costs include labor, materials, energy, equipment replacement, disposal, and sampling necessary to implement the alternative. The objective of the cost analysis is to eliminate those alternatives that (1) do not provide measurably greater protection of human health and the environment, and (2) include costs that are substantially greater than those of other alternatives.

The present worth analysis is used to evaluate expenditures that would occur during different time periods. By discounting all costs to a common base year (i.e., 1994), the costs can be compared on the basis of a single figure for each alternative. Total present worth costs were calculated by multiplying the capital and O&M cost incurred during each year by the present worth factor. An interest rate of 5% and a project duration of 3O years was used in accordance with EPA guidance.

The estimated costs associated with each alternative are shown in Table 4. The total present worth costs range from $22,300 for Alternative 1 to $ 22,312,400 for Alternative 10. Alternatives that include site-wide groundwater treatment have high capital and O&M costs, whereas alternatives that address localized contamination have medium capital and O&M costs. However it should be noted that the 30-year estimate for project duration may not be accurate for those alternatives involving goundwater treatment. It is not expected tihat groundwater upgradient of OU4 will attain MCLs in the foreseeable future, nor is it known if the groundwater pump and treat component of Alternatives 5 through 10 will be capable of removing all groundwater contamination in a 30-year period. Therefore, costs associated with Alternatives may be significantly higher than estimates provided in Table 4. Alternatives that incorporate removal of the LNAPL plume, rather than containment of the plume, have relatively lower present worth costs. Cost savings in those alternatives that include LNAPL

TABLE 4

COSTS ASSOCIATED WITH ALTERNATIVES DEVELOPED FOR OU4
(1994 DOLLARS)

ALTERNATIVE NO.	CAPITAL COSTS	ANNUAL O&M COSTS	TOTAL PRESENT WORTH
1	$0	$8,000	$22,300
2	$37,300	$186,200	$2,799,000
3	$256,200	$241,400	$3,866,500
4	$2,683,200	$359,000	$8,101,300
5	$2,847,600	$392,700	$8,783,700
6	$448,600	$250,700	$4,201,900
7	$3,146,600	$567,200	$11,765,200
8	$1,435,800	$484,300	$8,780,000
9	$5,158,500	$1,117,500	$22,236,600
10	$5,202,100	$1,119,600	$22,312,400

removal (Alternatives 3, 6, 8, and 10) are anticipated by utilizing the existing OU1 SVE system and treatment facilities as well as associated O&M activities, as opposed to building and operating new facilities.

H. State Acceptance

This criterion evaluates technical and administrative issues that may be raised by the State. EPA has involved CDH throughout the RI/FS and remedy selection process. The State of Colorado concurs with EPA's selected alternative, as presented in Section IX.

I. Community Acceptance

This criterion evaluates questions and comments on the Proposed Plan received from members of the community. Few comments were received on the OU4 Proposed Plan, and it appears that community accepts EPA's selected remedy, as presented in Section IX. EPA's responses to oral and written comments are provided in the Responsiveness Summary of this ROD (Appendix A).

IX. SELECTED REMEDY

EPA has selected Alternative 3 as the remedy for OU4. The remedial action selected for OU4 will restrict direct contact with and ingestion of groundwater underlying the Site and will protect currently uncontaminated groundwater. Five-year reviews of the Site will be required because contaminants will remain at OU4 following completion of the remedial action. This remedy is comprised of the following components:

Groundwater and Surface Water Monitoring - Existing and future groundwater monitoring wells (a total of approximately 16) will be sampled and analyzed periodically throughout OU4 to assess the effectiveness of ongoing remedial activities or changes in natural conditions. Samples will be analyzed for the presence of VOCs, semi-volatile compounds, pesticides, and metals. Monitoring points wii1 be located upgradient of the Site (to detect contamination from other sources), downgradient of the LNAPL plume (to track potential plume movement), downgradient from OU4 (to detect contaminant migration off site), within Sand Creek (to assess the impacts of contaminated groundwater possibly discharging to surface water) and immediately north of Sand Creek (to detect any potential migration of contaminants under the creek). Samples will initially be collected quarterly for at least one year but may be collected less frequently (i.e., semi annually or annually) if data indicate that site conditions are not changing significantly on a quarterly basis. For costing purposes, it was assumed that quarterly monitoring would be conducted for a period of 30 years. However, actual monitoring will continue for as long as contaminant concentrations in groundwater at the Site boundary exceed SDWA MCLs or state groundwater standards. In addition, the five private wells that are completed in the shallow alluvium in the vicinity of OU4 will be sampled once and evaluated as part of the OU4 groundwater monitoring program. EPA and CDH will notify and provide recommendations to the users if contamination is detected.

Institutional Controls - EPA and CDH will coordinate with local officials and property owners, and will request the implementation of institutional controls at the Site. Zoning restrictions, including recommendations against well usage for domestic purposes, will be implemented to the extent possible to prevent future human exposure to contaminated groundwater underlying the site. These objectives are already achieved in part through state advisaries against the construction of water wells in areas with known contamination. Additional institutional controls that may be implemented as necessary include subdivision regulations, building permits, recording requirements, state statutes, local ordinances, and deed restrictions and notices implemented by current property owners. Table 5 provides additional information on the institutional controls available for OU4.

LNAPL Removal - A DVE system (Figure 9) will be used to remove both LNAPL vapors and liquids from the subsurface. Vapors will be extracted by applying a vacuum to the well, as in SVE. The applied vacuum will also create a hydraulic gradient toward the well, causing LNAPL and groundwater to flow to the extraction well. LNAPL can then be recovered without creating a drawdown of the water table.

Higher overall removal rates can be achieved using a DVE system, as opposed to pumping liquids only. The greater removal efficiency is achieved by extracting vapors from the LNAPL plume as

well as liquids. In addition, drawing air through the subsurface enhances biodegradation of additional LNAPL in situ, further expediting remediation. By combining liquids extraction, volatilization, and biodegradation, a DVE system is considered to be significantly more effective than a liquids only extraction system. It is expected that the excess capacity of the catalytic oxidation unit in operation at the OU1 SVE system can be used for treating vapors removed by the DVE wells, thereby reducing construction time and costs.

Approximately twenty DVE wells will be installed in the center of the LNAPL plume area shown in Figures 7 and 8. The location of the wells will be restricted based on planned OU5 excavation activities. LNAPL vapors and liquid removed from the subsurface will pass through an air/liquid separator, and the resulting liquids stream will flow through an oil/water separator to recover free-phase LNAPL. Recovered LNAPL will be transported off site to a recycling facility. Water from the oil/water separator will be piped to an on-site groundwater treatment facility. LNAPL vapors from the air/liquids separator will be transported by pipeline to the SVE system in operation at OU1 for treatment by the existing catalytic oxidation unit.

Water received at the treatment facility from the DVE oil/water separator will first be pre-treated for metals removal using chemical precipitation followed by sedimentation. Groundwater pretreatment for metals is necessary to prevent potential fouling and clogging of the air stripper. The water will then pass through the air stripper where volatile contaminants will be removed. In particular, air stripping will remove vinyl chloride and methylene chloride which would tend to pass through the GAC unit. Treatment of the off-gas from the air stripper with a thermal or catalytic oxidation unit may be required depending upon the level of emissions. Liquid phase GAC will follow as the final treatment process. However, a detailed engineering evaluation could result in a re-sequencing of the air stripping and GAC treatment processes. Spent GAC will be regenerated off site.

TABLE 5

INSTITUTIONAL CONTROLS AVAILABLE FOR OU4

Process Option	Purpose	Measures	Existing/Available Institutional Controls	Development of New Institutional Controls
Zoning and Deed Restrictions	Limit or prohibit certain uses of the property (deed restrictions, easements, covenants). Alert potential future buyers of property to site risks (deed notice). Control the development of site land (zoning, permits).	Deed restrictions, deed notices, easements, covenants, permits.	The OU4 site area falls within an area already zoned for industrial use under the existing Commerce City Zoning Ordinance. Existing laws prohibit residential development in those portions of the site designated as I-2 or I-3. Colorado Rev. Status 30-38-114 gives the Adams County Commissioner authority to enforce zoning by issuing fines and imprisonment for violators. County zoning, however, could be revised to change the current zoning of the OU4 site area in the future. Existing Commerce City Subdivision Regulations allow the city council to prohibit, control or restrict subdivision/development of property that could place present or future inhabitants of the area at risk. The regulations also require a title check that should disclose any recorded information relating to past site use and hazards. EPA could negotiate a settlement with the PRPs which includes attaching a deed notice or restriction to property owned by the PRPs.	EPA could negotiate a CERCLA Section 122 Consent Decree with OU4 potentially responsible parties (PRPs) restricting OU4 land use. EPA may include in Section 122 Consent Decrees penalty provisions for violation of the decree. EPA could petition the Colorado Land Use Commission to require a hearing to decide if OU4 should be designated as an "Area of Interest" under the Land Use Act. Such a designation would require any potential developer to obtain a permit prior to the development of any portion of the site. Persuade the record owners of OU4 property by deed to create an Easement in Gross to restrict development of their property.
Municipal Water Supply	Minimize the use of OU4 groundwater as a domestic/potable water source.	Require use of existing municipal water supply.	Existing zoning laws contribute to prevention of use of OU4 groundwater for domestic purposes (OU4 groundwater is currently not being used for domestic purposes). Existing Commerce City subdivision regulations require the collection and analysis of water samples prior to subdivision or development of the property for both residential and non-residential development. Any such sampling at OU4 would disclose the contaminated state of the groundwater and prevent, by law, a developer from using the groundwater for drinking purposes if the proposed development site is underlain by contaminated groundwater, Commerce City would require an agreement from SACWSD, or the Denver Water Department if applicable regarding the supply of municipal water to the new development.	EPA could negotiate a CERCLA 122 Consent Decree with OU4 PRP's restricting groundwater use. EPA could petition the Colorado State Engineer to advise against the drilling of new wells in the OU4 site area. The City Council of Commerce City has the authority under Colorado Rev. Statute 31-15-708 (1) (c) to enact an ordinance prohibiting the drilling or use of wells in area in which the groundwater is deemed injurious to health. Commerce City has the authority under Colorado Rev. Statute 31-16-101 to enforce ordinances such as well restriction ordinances with fines and imprisonment.

Figure 9. Dual Vapor Extraction (DVE) System

Treated groundwater will be injected upgradient of the extraction wells. EPA permitting (SDWA UIC Class 5 permit) and testing prior to injection will occur as necessary.

Remediation Goals and Performance Standards. Remedial action objectives (RAOs) developed for OU4 are:

- Prevent direct contact with and ingestion of groundwater; and
- Protect uncontaminated groundwater for current and future use by preventing further migration of contaminants (both LNAPL and dissolved phase) in excess of federal and state drinking-water standards.

The DVE system will be designed to remove the mobile portion of the LNAPL plume located near the COCC and LCC properties in the northwest portion of OU4. The current estimated extent of this plume is indicated in Figures 7 and 8. Approximately 50% (190,000 gallons) of the total LNAPL volume at OU4 is estimated to be mobile under normal fluid flow, but a greater amount of LNAPL recovery is expected due to the addition of residual LNAPL removal through volatilization by the DVE system. The initial vapor-phase LNAPL removal rate is expected to be equivalent to approximately 200 gallons per day. The initial liquid-phase LNAPL removal rate is more difficult to estimate due to the lack of sufficient pump test data and uncertainties regarding the actual LNAPL plume thickness. However, an estimated removal rate of approxiamtely 25 to 75 gallons per day of liquid LNAPL appears reasonable based on the limited data.

Completion of removing the recoverable LNAPL will be determined based on monitoring of vapor emissions from the DVE system. Sampling of vapors will occur under equilibrium conditions and will be conducted on a monthly basis. Cleanup of the recoverable LNAPL will be considered completed when the LNAPL vapor removal rate of the DVE system becomes asymptotic. The specific criteria that must be met for completion of LNAPL removal are: (1) a greater than 90% reduction from initial vapor concentrations must be achieved, and (2) the LNAPL removal rate must be less than 10% per month for a three consecutive month period.

Groundwater and surface water monitoring at OU4 will be performed indefinitely until concentrations of contaminants meet applicable or relevant and appropriate federal and state standards. The duration of the OU4 monitoring program will be largely dependent on remediation of upgradient groundwater contamination. Remedial action at the Chemical Sales Company Superfund Site, located immediately southeast of the 48th and Holly Landfill, is expected to begin during the summer of 1994 and will address a source of the VOC contamination present in the eastern portion of OU4.

The points of compliance at OU4 will be groundwater and surface water at Sand Creek along the northern (downgradient) boundary of the Site, and at the groundwater injection wells. Contaminated groundwater attributable to the Site will be required to meet SDWA MCLs and more stringent state groundwater standards at the points of compliance. Contaminant levels in groundwater monitoring wells at the Site will be evaluated and compared with upgradient (i.e., background) contaminant. Table 6 presents the action levels for those COCs at OU4 that have an established federal or state drinking-water standard.

TABLE 6

REGULATORY STANDARDS FOR CHEMICALS OF CONCERN AT OU4

OU4 Chemical of Concern	Concentration (mg/l)	Source
Benzene	0.005	CIOPS
Chlorobenzene	0.100	CIOPS
Chloroform	0.006	CIOPS
CPMSO	0.02	EPA
2,4-D	0.07	SDWA MCL
4,4-DDT	0.0001	CIOPS
1,2-Dichlorobenzene	0.6	SDWA MCL
1,4-Dichlorobenzene	0.075	SDWA MCL
1,1-Dichloroethene	0.007	SDWA MCL
trans-1,2-Dichloroethene	0.1	SDWA MCL
Dieldrin	0.000002	CIOPS
Ethylbenzene	0.680	CIOPS
Methylene Chloride	0.005	SDWA MCL
Lindane (gamma-BHC)	0.0002	SDWA MCL
Styrene	0.1	SDWA MCL
Tetrachloroethene	0.005	SDWA MCL
Toluene	1	SDWA MCL
1,1,1-Trichloroethane	0.2	SDWA MCL
Trichloroethene	0.005	SDWA MCL
Vinyl Chloride	0.002	SDWA MCL
Xylenes (total)	10	SDWA MCL
Antimony	0.006	SDWA MCL
Arsenic	0.05	SDWA MCL
Selenium	0.01	CIOPS

CIOPS	Colorado Interim Organic Pollutants Standards
SDWA MCL	Safe Drinking Water Act Maximum Contaminant Level
EPA	EPA Memorandum on Toxicity of p-Chlorophenylmethyl Sulfide and its Oxidation Products; from Robert Benson, Ph. D., Toxicologist to Larry Diede (January 21,1994).

The groundwater standard for CPMSO was established based on a toxicological study performed by EPA. Concentrations of COCs that do not have a federal or state drinking-water standard will also be monitored, and potential risks associated with detected concentrations of these contaminants will be evaluated.

X. STATUTORY DETERMINATIONS

EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, CERCLA § 121 establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for a site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is justified. The selected remedy must also be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatments that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following discussion addresses how the selected remedy meets these statutory requirements.

A. Protection of Human Health and the Environment

EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (1988) indicates that protectiveness may be achieved by reducing exposure through actions such as containment, limiting access, or providing an alternative water supply. A containment system does not appear to be necessary at OU4 at this tune because the LNAPL and dissolved-phase contaminant plumes are not migrating significantly. This is due to a relatively flat hydraulic gradient at the Site and the presence of impermeable days that inhibit contaminant transport.

Since groundwater is not currently used for drinking water or other domestic uses, there is presently not a significant health risk at OU4 because of a lack of completed exposure pathways. The risks associated with potential future exposure scenarios are adequately addressed in the selected remedy by the implementation of LNAPL removal, institutional controls, and monitoring. Removal of the recoverable LNAPL will minimize potential discharges to Sand Creek, the Metro Waste Water sanitary sewer system, downgradient water supply wells, and will eliminate a potential source of groundwater contamination. Groundwater and surface-water monitoring will allow for evaluating the performance of the selected remedy and the need for additional action. The monitoring program conducted for the 48th and Holly Street Landfill under the OU3 Unilateral Order will also provide information on changes in groundwater quality at OU4.

Short-term and cross media impacts due to implementation of the selected remedy are expected to be minimal. Potential risks to human health and environment through exposure to contaminated groundwater and soil during well installation and construction of the DVE system will be minimized by the use of appropriate preventative and protective measures. Potential cross media impacts will be minimized by proper well construction methods.

Due to the presence of upgradient contamination, including petroleum product which is exempt from remediation under CERCLA, and the residual LNAPL contamination that is likely to remain at the Site, institutional controls must be used at OU4. The institutional controls will minimize risks associated with potential future use of contaminated groundwater. Although CERCLA favors active remediation, institutional controls may be implemented under CERCLA in appropriate circumstances. As provided by the Preamble to the NCP (55 Federal Register 8666-87O6 [March 8,1990]):

> Examples of institutional controls, which generally limit human activities at or near facilities where hazardous substances, pollutants, or contaminants exist or will remain onsite, include land and resource use and deed restrictions, well drilling prohibitions, building permits, and well use advisories and deed notices. EPA believes ...that institutional controls have a valid role in remediation and are allowed under CERCLA (e.g., Section 121(d)(2)(B)(ii) appears to contemplate such controls). Institutional controls are a necessary supplement when some waste is left in place, as it is in most response actions. Also, in some instances where the balancing of tradeoffs among alternatives during selection of remedy process indicates no practicable way to actively remediate a site, institutional controls such as deed restrictions or well-drilling prohibitions are the only means available to provide protection of human health.

B. Compliance with ARARs

The selected remedy will comply with all federal and state ARARs. ARARs which must be considered include those that are chemical-, action-, and location-specific. Potential ARARs identified for OU4 were described in Table 3 and are listed below for the selected alternative:

Chemical-specific: For compliance with pertinent chemical-specific ARARs, contaminated groundwater attributable to the Site will be required to meet applicable SDWA MCLs (40 CFR Part 141) and applicable state groundwater standards such as the Colorado Classification and Water Quality Control Act and the Colorado Basic Standards for Groundwater (5 CCR 1002-8) at the downgradient Site boundary. Contaminant levels in groundwater monitoring wells at the Site will be evaluated and compared with upgradient (i.e., background) contaminant concentrations. Groundwater that is removed incidentally by the DVE system and subsequently treated will also need to meet these groundwater standards prior to injection. The groundwater treatment facility included in the selected remedy will be capable of achieving these applicable regulatory

standards.

Action-specific: Treatment residuals from the LNAPL removal system will be transported off site in compliance with HMTA (applicable) and RCRA (applicable) requirements if the residuals are considered to be hazardous. Disposal of any hazardous treatment residuals will occur off site at a RCRA Subtitle C treatment, storage, or disposal (TSD) facility. Wells installed for the OU4 monitoring program and the abandonment of existing unneeded wells will be subject to the Colorado Revised and Amended Rules and Regulations of the Board of Examiners of Water Well Construction and Pump Installation Contractors (2 CCR 402-2). EPA permiting (SDWA Underground Injection Control Regulations, Class 5 permit) and testing prior to injection of groundwater will occur as necessary.

Most of the air ARARs depend on emission sources and, therefore, are action specific. Because there are no major sources of emissions at OU4, these ARARs pertain to activities associated with the selected remedy, rather than to existing conditions. The selected remedy will comply with the following air ARARs:

- National Ambient Air Quality Standards (NAAQS) - Particulate emissions will be controlled during construction activities, and VOC emissions, which act as a precursor to ozone formation, will be managed during remedial action. The selected remedy will not cause or contribute to violations of the NAAQS.

- Colorado Ambient Air Quality Standards - The selected remedy will comply with state-specific standards for lead and total suspended particulate matter.

  - Regulation 1 - The selected remedy will comply with provisions regarding opacity limitations and control of particulate emissions that apply to construction activities.

  - Regulation 2 - All actions taken at OU4 will be in compliance with state odor regulations.

  - Regulation 3 - Air Pollution Emisssion Notices (APENs) will be filed for each stage of activity, including construction, and operation of the DVE system and water treatment equipment.

  - Regulation 6 and Federal New Source Performance Standards - 4O CFR Part 60, Subpart FF contains provisions relating to VOC emissions from petroleum refinery wastewater systems. The selected remedy will meet relevant and appropriate portions of Regulation 6 and the New Source Performance Standards.

  - Regulation 7 - Reasonably Available Control Technology (RACT) for VOC sources within Colorado will be applied to the selected remedy.

  - Colorado Regulation 8 - limitations on beryllium and lead emissions will be met during construction if contaminated soils are disturbed. Relevant and appropriate limitations on mercury emissions will be attained if water treatment system sludge is dried. Relevant and appropriate provisions involving vinyl chloride emissions from specific types of equipment will also be met.

- National Emissions Standards for a Hazardous Air Pollutants (NESHAPs) - The selected remedy will meet relevant and appropriate portions of the NESHAPs (i.e., Subpart FF of 40 CFR Part 61).

Location-specific: Location-specific ARARs include the Executive Orders on Floodplain Management and Protection of Wetlands. Only a relatively small portion of the Site is located within the Sand Creek floodplain. Compliance with location-specific ARARs depends on the location of the treatment facility, monitoring wells, DVE wells, and groundwater injection wells. No protected properties have been identified in the immediate vicinity of OU4 and, the selected remedy will comply with location-specific ARARs.

Other Guidance, Criteria, or Advisories to be Considered (TBCs): Guidance regarding ambient air levels of toxic air pollutants (National Ambient Air Quality Standards, NAAQSs) will be considered for designing air pollution controls for the Site. The State of Colorado considers the Massachusetts Ambient Air Level standards as important guidance. EPA has issued a policy statement regarding air emission controls for air strippers at Superfund sites located in ozone non-attainment areas and considers this policy a TBC because Denver is an ozone non-attainment area (OSWER Directive 9355.0-28). The CERCLA Petroleum Exclusion which limits CERCLA authority and funding for removal and treatment of petroleum product is also identified as a TBCC for the selected remedy.

C. Cost Effectiveness

The selected remedy has been determined to provide overall effectiveness proportional to its costs and is therefore considered cost effective. The OU4 monitoring program will allow assessment of groundwater contamination attributable to the Site. The analysis of sampling data collected will provide information necessary for making cost-effective decisions regarding the need for future action at the Site. The alternative selected includes removal of the

recoverable LNAPL which is less expensive than containment and provides a relatively greater degree of protectiveness. Total capital, annual O&M, and present worth costs for the selected remedy are $256,200; $241,400; and $3,866,500; respectively. The selected alternative is the third least expensive option of the ten alternatives developed for OU4.

D. Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable at OU4. Site-wide remediation of OU4 was found not to be feasible because groundwater is not currently being used for domestic purposes, the existence of upgradient contaminant source(s), the inability of a groundwater pump and treat system to extract all of the residual contamination, and high cost of treating all groundwater beneath the Site. Removal of the recoverable LNAPL will permanently eliminate a potential source of groundwater contamination to OU4. Implementation and continued enforcement of institutional controls will minimize the potential for exposure to contaminated groundwater. However, the effectiveness of institutional controls is largely dependent on the continued cooperation of property owners, municipalities, and other governmental entities. The OU4 groundwater monitoring program will allow for evaluation of changes in groundwater quality, the detection of any offsite migration of contaminated groundwater, and the need for further action at the Site.

Of the alternatives that are protective of human health and the environment and comply with ARARs, EPA believes that the selected remedy provides the best balance in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; short-term effectiveness; implementability; and cost. Overall protection of human health and the environment, and cost were the most decisive criteria in selecting Alternative 3 as the preferred remedy.

E. Preference for Treatment as a Principal Element

Treatment of the principal threats at OU4 was found not to be attainable due to the presence of upgradient contaminant sources and limitations in EPA's response authority due to the Petroleum Exclusion. Therefore, the selected remedy does not satisfy the statutory preference for treatment as a principal element. However, many of the principal threats at the Site are being addressed under remedial actions occurring at other OUs and ultimately will eliminate or control sources of groundwater contaminants affecting the Site. LNAPL vapors removed by the DVE system will be permanently destroyed by a thermal or catalytic oxidation unit, and groundwater removed during operation of the DVE system will treated to SDWA MCLs or more stringent state drinking-water standards.

Because the selected remedy will result in hazardous substances remaining on site, a review will be conducted every five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

APPENDIX A

RESPONSIVENESS SUMMARY
SAND CREEK INDUSTRIAL SUPERFUND SITE, OPERABLE UNIT 4
COMMERCE CITY, COLORADO

1. OVERVIEW

The U.S. Environmental Protection Agency (EPA) established a public comment period from February 14, 1994 through March 16, 1994 for interested parties to comment on the Feasibility Study (FS) report and the Proposed Plan for Operable Unit 4 (OU4) of the Sand Creek Industrial Superfund Site in Commerce City, Colorado. EPA also held a public meeting at 5:30 p.m. on March 1, 1994 at the Commerce City Recreation Center to outline the proposed remedy for OU4. The preferred alternative includes monitoring and institutional controls with light non-aqueous phase liquid (LNAPL) removal.

The Responsiveness Summary, required by the NCP (4O CFR Part 300.430(f)(3)(i)(F)), provides a summary of comments received from the community during the public comment period, as well as EPA's responses to public concerns. All comments received during the public comment period were considered in EPA's final selection of a remedial alternative for OU4.

2. BACKGROUND ON COMMUNITY INVOLVEMENT

Most of the community involvement at the Sand Creek Site Industrial Site has stemmed from local officials and neighboring businesses. In the past, concern about liability and property values has been high in this community. Site-specific concerns identified through recent community interviews include credibility of the government, publicity and economic issues, the Superfund process, remedial activities, and health effects.

The following discussions identify the general nature of the concerns expressed by the community and indicate specific concerns where appropriate.

Credibility of the Government: Reportedly, a distrust of local, state, and federal government persists in this community. This distsust is attributed to contradictory statements made by government representatives and what some people feel is a historical cover-up of environmental problems. In addition, the tremendous amount of environmental contamination that has occurred in this community has made residents of Commerce City and the surrounding area feel like "governmental and scientific guinea pigs," according to one resident.

On one occasion, some individuals who work near the Sand Creek site requested information from the EPA about water and soil quality in the area. According to those interviewed, the EPA response was that the water was fine but there was a problem with soils at the Sand Creek Superfund Site. Because these individuals worked uphill from the Site, they were told at they were not at risk. The workers did not believe the EPA and have feelings of distrust toward the Agency.

Publicity and Economic Concerns: Residents of Commerce City feel that bad publicity has stifled the economy of the community and destroyed the area's ability to attract new business. A primary concern of local officials is that contamination in the area has been associated solely with Commerce City although area Superfund sites are also located in Denver and unincorporated Adams County.

Residents and business owners in the area are very concerned about property values. One local business owner said that he is unable to use his land for collateral and the property is virtually unsalable. Homeowners feel that a decline in property values can be attributed to the presence of Superfund sites in the area. Liability under Superfund has been a major concern during the history of the Sand Creek Site, but the issue has not been raised by the community recently.

The Superfund Process: Local officials, residents, and business owners expressed concern about the amount of time it takes to cleanup a site. Specifically, one individual said that by the time a remedy is about to be implemented, the treatment or disposal alternative that was selected in the ROD may not be appropriate for the site. Another concern is that contamination may have an opportunity to migrate while studies are being conducted and a remedy is being designed.

Several interviewees felt that the Superfund process was inefficient. One individual said that the Superfund process has become ineffective because a substantial portion of the Superfund money has been spent on legal fees.

Remedial Activities: Lack of information about environmental sampling, remedial activities, and protective clothing tends to intimidate and frighten people who work near the Site area. In addition, local employees expressed a desire to know the schedule of sampling and remedial activities in advance. Dusts generated during cleanup are a primary concern associated with remedial activity. The people want to be assured that the proper preventative measures are taken to limit the generation of dust, and that air quality near the Site is monitored adequately during cleanup work.

Health Effects: Some of the individuals interviewed associate personal physical problems with contamination in the area. The risks to pregnant women who work near the Site are of

particular concern to local employees. The community is also concerned about the overall air, water, and soil quality in the area.

EPA General Response: The Community Relations Program for the Sand Creek Industrial Superfund Site is improving the community's understanding of the data and the potential hazards associated with the site, as well as the Superfund process. The community has been kept informed of ongoing activities conducted at the Sand Creek site through mailings, newspaper announcements, and public meetings. A notice of availability of the OU4 Proposed Plan, RI, and FS reports and notification of the public meeting were published in The Rocky Mountain News on February 14, 1994 and in The Commerce City Express on February 15, 1994. The public comment period for the OU4 Proposed Plan was open from February 14 to March 16, 1994, and the public meeting was held on March 1, 1994 at the Commerce City Recreation Center. EPA explained the alternatives developed for OU4, presented its preferred remedy, and responded to questions. In addition, EPA has established an information repository at the Adams County Library and the EPA Superfund Records Center in Denver, Colorado where materials relevant to the community's concerns and interests may be reviewed. Documents pertaining to OU4 which are stored at the repository include: the Rl/FS reports, risk assessments, and related documents) and the Proposed Plan.

Because remedial actions for contaminated groundwater at Superfund sites often use similar technologies and approaches, EPA has developed guidelines designed specifically for addressing contaminated groundwater at these sites (EPA/540/G-88/003). This focused approach was adopted in conducting the RI/FS for OU4. Use of these guidelines helped to expedite the RI/FS and center the remedy selection on proven and widely used technologies, which ultimately resulted in a more efficient use of time and resources. By streamlining the RI/FS process EPA: (1) improves the efficiency and effectiveness of decision making at these sites; (2) provides consistency among the EPA Regions in their approach to conducting an RI/FS and selecting a remedy; and (3) facilitates more effective remedial designs.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) mandates that EPA protect human health and the environment from current and potential exposures to hazardous substances. Groundwater underlying OU4 was evaluated for potential human health and environmental risks posed by contaminants in several investigations at the Site. These studies evaluated baseline risks and potential future risks associated with exposures to current levels of contamination at OU4. The following documents describe risk evaluations performed at the Site:

- 1988 Preliminary Endangerment Assessment (EA) for the Sand Creek Industrial Site, Colorado: This document described a site-wide risk assessment that evaluated risks from contaminated soils, groundwater, surface water, and air at the Site.

- 1993 48th and Holly Street Landfiill (OU3) Risk Assessment: This document updated and supplemented the 1988 EA by incorporating new data presented in the OU3 Rl. The two media evaluated in this risk assessment were groundwater in the vicinity of the Landfill and landfill gas.

- 1993 Health Evaluation Update: This document was prepared as part of the OU4 RI/FS. It updated and supplemented the 1988 EA by incorporating new data collected during the OU4 RI/FS as well as data collected for the 1993 OU3 risk assessment. Groundwater and the LNAPL plume were the subjects of this evaluation. Results were compared with the previous EA study.

Protection of the community during remedial action is a primary concern of EPA. The preferred remedy for OU4 will meet all applicable or relevant and appropriate federal and state requirements. Monitoring will be performed during construction activities to evaluate the air quality, adequate controls will be used to suppress dust generation, and appropriate measures will be taken to protect workers and residents during remedial action.

3. SUMMARY OF COMMENTS RECEIVED DURING PUBLIC COMMENT PERIOD AND EPA RESPONSES

EPA solicited written and oral comments from the community on the OU4 Proposed Plan during the public comment period and at the public meeting. A summary of comments received and EPA's responses are provided below:

Comment: One participant at the public meeting wanted to know how many wells are in the Sand Creek Superfund site area, regardless of whether they were used for drinking water or agricultural purposes. He also wanted to know if the wells had been tested over a period of time.

EPA Response: A 1990 report prepared by Tri-County Health Department (TCHD; 1990)for EPA and the Colorado Department of Health (CDH) contains the most current information on OU4 area water use. The report summarizes the findings of a door-to-door well inventory and information survey. The survey encompassed an area bounded by Sand Creek on the north, Interstate 70 on the south, Quebec Street on the east, and Colorado Boulevard on the west. (This survey area extends beyond the boundaries of OU4.) The survey supported CDH and EPA efforts to identify potential receptors of groundwater contaminated by several sources, including sources at the Site. TCHD contacted property owners to determine the number, location, depth, construction details, and current use of wells in the survey area.

TCHD obtained information on water use from 419 of the 420 properties in the survey area. South

Adams County Water and Sanitation District and Denver Water Board serve most of the water users in the survey area. However, the survey identified 23 private wells, with nine completed in the shallow alluvium. Data regarding the depth of nine wells were unavailable. Four wells identified as deep ranged from 560 to 1600 feet depth, and thus are not in the shallow OU4 aquifers. Two of the deep wells provided water for drinking.

Of the wells completed in the shallow alluvium, five are in use. Three are used for irrigation and one as a seasonal water supply for livestock. The remaining well, located at a business on Oriental Refinery property, provides water for a sanitary waste system. These wells have not been sampled by EPA in the past, but will be included in the OU4 monitoring program.

Within the OU4 site boundary, there are approximately 80 groundwater monitoring wells. EPA intends to permanently abandon those monitoring wells that will not be sampled in the OU4 and OU3 groundwater monitoring programs.

Comment: A city council member at the public meeting felt that the proposed remedy for OU4 was primarily a monitoring function and was not sufficient because it addressed only a limited geographic area. He believed that this has a direct effect on the marketability and economics of the area, the willingness of the people to invest in the area, and establishing permanent commercial and industrial use of the land.

EPA Response: Groundwater underlying the Sand Creek site does not appear to be migrating due to the nature of the aquifer system and the presence of clays. EPA believes that monitoring is an appropriate response for the conditions at the Site. The proposed remedy for OU4 also includes the implementation of institutional controls which will minimize potential exposure to contaminated groundwater. The dual vapor extraction (DVE) system will be used for removing LNAPL, a potential source of groundwater contamination. The groundwater monitoring component of the preferred alternative will not interfere with industry in the area and will provide protection by detecting any offsite migration of contaminants and the need for further action at the Site.

Remedial action is underway at other nearby Superfund sites, and collectively these activities will reduce risks associated with contamination in the area. By cleaning up these sites, the potential environmental liability associated with the affected properties is reduced, the property values increase, and the marketability of the area is enhanced.

Comment: A community member at the public meeting wanted to know what would be done with the groundwater that will be removed during operation of the DVE system.

EPA Response: Contaminated groundwater that is extracted along with the LNAPL by the DVE system will be treated at the site for the removal of organic and metal contaminants and will be returned to the alluvial aquifer system by onsite groundwater re-injection or infiltration. Specific engineering details of the groundwater treatment and re-injection system will be developed during the remedial design phase of the project. It is currently estimated the groundwater removal rate during operation of the DVE system will be approximately 20 gallons per minute (gpm).

Comment: A written comment was received indicating concern that groundwater issues that have been evaluated and addressed under OU3 are not explicitly excluded from coverage under OU4 in the Proposed Plan. The author asked EPA to clarify in the OU4 ROD that groundwater in the vicinity of the 48th and Holly Landfill has been addressed under the OU3/OU6 Remedial Design/Remedial Action (RD/RA) as specified in the Statement of Work to the OU3/OU6 Unilateral Administrative Order (UAO) for RD/RA.

EPA Response: Due to the limited available space and the scope of the Proposed Plan, only a general overview of OU3/OU6 activities was provided. The OU4 ROD indicates that groundwater beneath the Landfill and related to the Landfill is addressed in the OU3/OU6 ROD.

Comment: Another written comment was received concerning Table 2 (Remedial Alternative Screening Matrix) of the OU4 Proposed Plan. The author believed that the longterm effectiveness and permanence of Alternative 2 (i.e., monitoring and institutional controls) should be designated as "limited" rather "none" because these actions provide reliable controls for future management of untreated materials and thereby reduce the residual risk associated with the Sand Creek Superfund Site.

EPA Response: Compared with the other alternatives developed for OU4, Alternative 2 provides the second lowest degree of long-term effectiveness and permanence. Alternative 2 is largely dependent on the willingness of property owners and local governments to implement and enforce institutional controls. EPA has little authority with respect to establishing and enforcing institutional controls. However, the proposed remedy for OU4 (Alternative 3) combines LNAPL removal with institutional controls and groundwater monitoring and, therefore, provides a greater degree of long-term effectiveness and permanence.